The New Zealand

Journal of Agriculture.

VOL. 41. WELLINGTON, 20TH OCTOBER, 1930. No. 4.

DAIRY-HERD TESTING IN NEW ZEALAND.

REVIEW OF THE 1929–30 SEASON.

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THE season of 1929–30 must be regarded as an outstanding period in the herd-testing movement of New Zealand, having witnessed the first year's work of the Herd-testing Central Executive and of the Federation Supervisor of Herd-testing, while it was also marked by a larger number of cows under test and a higher average butterfat-production than has been hitherto recorded.

Already the Central Executive has accomplished much by way of formulating policies for improving and extending the movement, and has also suggested alterations to the method of allocating future subsidies, which, if put into operation, should be of considerable assistance to weak and newly formed organizations. The Federation Supervisor has paid visits to practically every district in New Zealand, and, apart from bringing about many improvements and economies in the working of existing groups and associations, and standardizing practice generally, he has been successful in increasing the membership of several groups, as well as assisting the establishment of a number of new groups in districts where no systematic herd-testing was previously being done. There has been, in fact, a representative and systematic supervision of the entire operations.

Returns received indicate that 283,731 cows were tested in 1929–30, an increase of 24,137 over the 1928–29 total of 259,594. Last year's number represents 20·4 per cent. of the total of the Dominion's dairy cows in milk, or 19·7 per cent. of all cows—in milk and dry. The increased total is the result of more group testing, the other branches of ordinary herd-testing having shown a falling-off.

Group herd-testing has shown remarkable progress. The system was inaugurated in 1922, and commenced with six groups comprising 7,500 cows. During the season 1922–23 there were 84,825 cows on test in the Dominion, so that the group quota was only 8·84 per cent. of the total. Each year has shown an increase in group testing, until for the season under review there were 184 groups in operation with a total of 242,688 cows, or 85·5 per cent. of grand aggregate of cows tested.

Table 1.—Number of Cows tested Twice or more, classified according to Season and System of Testing.

System.	1925–26.			1926–27.			1927–28.			1928–29.			1929–30.		
	Organizations.	Cows.	Average Cows per Organization.	Organizations.	Cows.	Average Cows per Organization.	Organizations.	Cows.	Average Cows per Organization.	Organizations.	Cows.	Average Cows per Organization.	Organizations.	Cows.	Average Cows per Organization.
Association	124	59,345	479	116	56,823	489	115	56,699	493	99	45,586	460	98	40,667	415
Group ..	86	105,227	1,224	96	109,827	1,144	127	164,610	1,296	158	212,480	1,344	184	242,688	1,319
Dairy Company	38	5,204	137	28	3,500	125	18	2,821	157	8	1,528	191	6	376	63
All ..	248	169,776	685	240	170,150	709	260	224,130	862	265	259,594	979	288	283,731	985

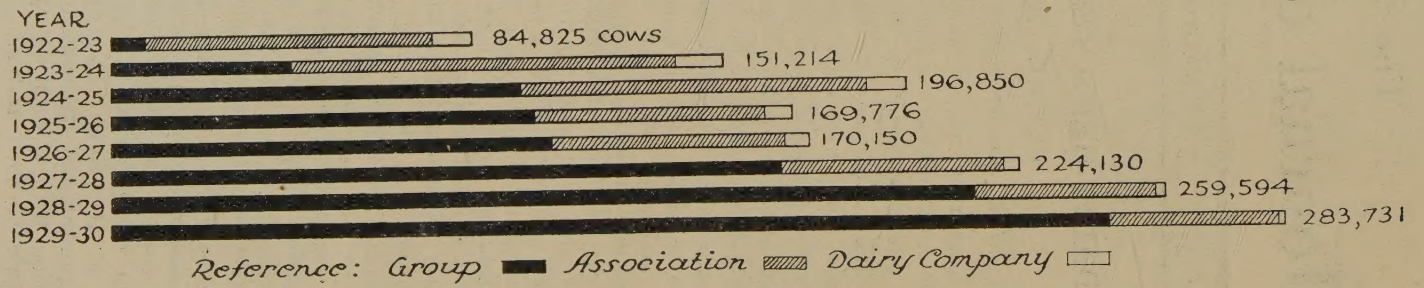

FIG. 1. GRAPHICAL REPRESENTATION OF EXTENT AND SYSTEMS OF HERD-TESTING IN NEW ZEALAND FOR LAST EIGHT SEASONS.

The statistical survey which follows adheres to the procedure usually followed in the presentation of our annual herd-testing review. It does not pretend to be more than a summary of results for cows tested in the Dominion. It is impossible to take into consideration the finer details of the subject—that is to say, the different rules and bases of figuring recognized by different organizations, details as to the varying classes of cows and of land throughout the various districts, land-values, detailed climatic conditions, and other points which would be essential to make the review entirely complete and authoritative. The three main terms adopted in the past have been retained—namely, "Group," "Association" (sometimes called "Individual," and lately changed to "Association Own-sample Test" on the recommendation of the Central Executive), and "Dairy Company." Under the group system a testing-officer visits the farm and takes samples one day a month, whereas under the Association and Dairy Company systems the owner takes his own samples, usually for two days a month, and the association officer or the dairy-company manager arranges for the testing.

A classification under these three systems is given in Table 1, five seasons being shown for purposes of comparison. The table indicates the position outlined in our introductory remarks, and makes it quite clear that the group system has increasingly dominated the movement, until the other systems combined claim a relatively small percentage of the total number of cows tested. The graph shown beneath the table covers the period since the inauguration of the group system in 1922–23, and is interesting from the point of view of indicating the proportion of support accorded to each of the three systems named.

The past season showed an increase in the number of cows tested in every land district except Southland and Canterbury. Westland was again the only land district in which no systematic herd-testing was carried out. In next year's review, however, we hope to be able to make a more favourable report on this area. Five groups have now been formed in Westland, and we look forward with interest to reviewing the result of their first season's operations. Nelson and Marlborough, and particularly Otago, have shown creditable increases.

Table 2 provides a statistical summary of the number of cows tested in each of the various land districts. This year we are able to add a column showing the percentage which the tested cows bear to the total cows in milk. The most striking points are the comparatively low position of Taranaki, in the North Island, and that in the South Island those districts which might be considered the more specialized dairying region test a relatively small proportion of their cows.

Table 3 affords a general review of the number and size of the various organizations operating throughout the year, and it is interesting to note that there is an advancement under practically every heading. Seeing that practically all the organizations are Group it is not reasonable to expect much alteration under the fourth heading, as the number of herds per group is governed by workability. For the benefit of those readers who are not conversant with the subject it may be explained that the term "organization" as here used denotes any herd-testing

Table 2.—Number of Cows tested Twice or more, classified according to Season and Land District, &c.

Land District, &c.	1925–26.	1926–27.	1927–28.	1928–29.	1929–30.	Percentage of Tested Cows to Total Cows in Milk, 1929–30.*
North Auckland ..	24,951	24,616	41,067	48,713	58,113	24·5
Auckland	77,651	82,338	101,796	106,823	109,811	26·8
Gisborne	3,891	2,626	5,756	9,579	12,329	33·4
Hawke's Bay ..	4,902	2,987	4,638	8,243	8,505	17·0
Taranaki	16,485	14,696	23,581	30,298	31,693	15·1
Wellington ..	29,653	29,517	32,267	36,547	42,224	21·1
North Island ..	157,533	156,780	209,105	240,203	262,675	23·0
Nelson	880	620	656	1,241	2,128	8·0
Marlborough ..	441	258	434	2,176	3,628	23·7
Westland	..	74	..	..	..	..
Canterbury ..	1,799	4,292	3,280	3,524	2,816	3·8
Otago	903	950	769	581	2,975	5·7
Southland ..	8,220	7,176	9,886	11,869	9,509	13·7
South Island ..	12,243	13,370	15,025	19,391	21,056	8·5
Dominion	169,776	170,150	224,130	259,594	283,731	20·4

* As at 31st January, 1930.

body, whether Group or Association. Moreover, the term applies to each individual unit—that is to say, an organization operating ten groups would be included as ten, not as one. It will be observed that the number of cows per herd is steadily increasing. The explanation is not so much that our herds are increasing in size, but rather that practically all group organizations insist upon every normal cow in the herd being tested. By an "effective" summary is meant that the table is compiled from individual summaries sufficiently complete and reliable to justify inclusion.

Table 3.—Number of Cows, Herds, and Organizations represented in Effective Seasons' Summaries received. (Basis : All Cows in Milk 100 Days or over.)*

—	1927–28.	1928–29.	1929–30.
Number of organizations	242	257	282
Number of herds	5,927	6,663	7,107
Number of cows	206,323	245,811	272,554
Average number of herds per organization	24	25	25
Average number of cows per herd ..	35	36	38
Average number of cows per organization ..	853	956	967

* Including both Group and Association systems, and on basis of sections or units.

Table 4 provides a classification of groups and associations according to herds and cows. The most noticeable feature is the marked decrease in the average size of the associations.

Table 4.—Average Size of Associations and Groups for which Effective Seasons' Summaries on the Basis of all Cows in Milk 100 Days or over were received.

System.	Season.	Average Number of Herds per Association or Group.	Average Number of Cows per Association or Group.	Average Number of Cows per Herd.
Association ..	1925–26	19	407	22
	1926–27	18	408	22
	1927–28	21	414	20
	1928–29	20	401	19
	1929–30	20	363	19
Group ..	1925–26	27	1,205	44
	1926–27	26	1,127	43
	1927–28	28	1,250	45
	1928–29	29	1,304	44
	1929–30	28	1,288	46

Table 5 supplies a grand summary of production results for the past two seasons, the figures being taken out under the separate as well as the combined headings of Group and Association. It will be noted that the average yield for all tested cows has risen from 240·50 lb. butterfat in 1928–29 to 253·61 lb. in 1929–30. This is an exceedingly satisfactory increase, more particularly as the position can scarcely be credited to climatic conditions.

Table 5.—Grand Summary of all Effective Herd-testing Results on the Basis of all Cows in Milk 100 Days or over received for the Last Two Seasons.

—	1928–29.			1929–30.		
	Number of Cows.	Days in Milk.	Butterfat-production.	Number of Cows.	Days in Milk.	Butterfat-production.
			lb.			lb.
Average for all cows	245,811	242	240·50	272,554	247	253·61
Highest Group average ..	984	276	304·71	1,113	281	318·42
Lowest Group average ..	3,199	215	170·40	1,025	194	173·96
Highest Association average ..	105	273	358·50	5	293	440·93
Lowest Association average ..	190	140	131·76	108	143	150·04
Highest Group herd	21	329	428·00	7	275	455·43
Lowest Group herd	34	111	83·00	15	117	78·46
Highest Association herd ..	4	322	475·70	5	288	485·54
Lowest Association herd ..	10	120	77·13	12	139	71·19
Highest Group cow	..	305	888·00	..	350	886·00
Lowest Group cow	..	105	8·00	..	130	11·00
Highest Association cow ..	..	350	704·20	..	285	639·00
Lowest Association cow ..	..	120	19·02	..	100	20·00
Average daily production of butterfat for all Group cows	..	..	0·98	..	..	1·01
Average daily production of butterfat for all Association cows	..	..	1·05	..	..	1·11

The collection of data necessary to compile a table of this nature, and in fact the majority of the tables given in this survey, entails considerable work on the part of the officers in charge of the various herd-testing organizations. The effective summaries received for the past season represent 96·3 per cent. of the total number of cows tested twice or more, the highest percentage we have yet been able to record. We

should once more like to express appreciation for the service which the persons concerned have so willingly and courteously rendered. The systematic and comprehensive recording of returns and the subsequent sifting and analysing is a very important factor in the success of the herd-testing movement.

The increase in the production of the average tested cow is better appreciated after a study of Table 6. This table covers the past five years as regards the dairy-cow population of New Zealand. This year we have added a column showing the percentage of dry cows to total cows, and it will be noticed that in the five-year period the percentage has decreased from 9·38 to 3·57. There were 97,688 more cows milked last season than the season before, despite the fact that the total cows increased by only 69,255, a decrease of 28,410 being recorded in dry cows. This, taken in conjunction with the increased average production per cow, represents in itself a very substantial increase in butterfat production.

Table 6.—Cows in Milk and Dry.

Season.	Total Cows.	Cows in Milk.	Dry Cows.	Percentage of Dry to Total Cows.
1925–26 ..	1,303,856	1,181,441	122,415	9·38
1926–27 ..	1,303,225	1,181,545	121,680	9·33
1927–28 ..	1,352,398	1,242,729	109,669	8·10
1928–29 ..	1,371,063	1,291,204	79,859	5·82
1929–30 ..	1,440,321	1,388,872	51,449	3·57

Table 7, which embraces four years, classifies the production of tested cows according to system of operation, the two principal systems —namely, Group and Association—being shown. The Association system shows a falling-off under each heading except the two important ones of average days in milk and average butterfat, while there is a considerable increase under each Group heading. The steady advance of the length of the average lactation is a gratifying feature. In perusing this table two points immediately attract attention. Firstly, the Association yield is higher in relation to days in milk, and, secondly, the average days in milk for Group cows is twenty-eight days

Table 7.—Average Production of all Effective Results for Past Four Seasons classified according to System. (Basis: All Cows in Milk 100 Days or over.)

Season.	System.	Number of Associations or Groups.	Number of Herds.	Number of Cows.	Average Days in Milk.	Average Butterfat.
						lb.
1926–27 ..	Association	115	2,140	46,878	220	232·64
	Group ..	96	2,538	108,150	241	243·88
1927–28 ..	Association	115	2,389	47,589	204	212·07
	Group ..	127	3,538	158,734	237	228·46
1928–29 ..	Association	99	2,000	39,722	222	234·33
	Group ..	158	4,663	206,089	246	241·69
1929–30 ..	Association	98	1,921	35,613	223	248·88
	Group ..	184	5,186	236,941	251	254·32

more than for Association cows. The explanation of the first point mentioned lies probably in the fact that in many instances only selected cows from the better herds are placed under Association test, whereas, speaking broadly, Group rules provide that the entire herd must be entered for test. The more complete recording system, and the fact that the testing officer's visit more or less compels the taking of samples and milk-weights until drying off would doubtless explain the longer Group-testing period.

In Table 8 average production has been classified on the basis of all cows in milk 100 days or more and 210 days or more. This summary applies only to those associations conducted by the Dairy Division's testing officers and the returns figured at the Division's headquarters. It is necessary to know the average production of all tested cows, irrespective of length of lactation, and no summaries are truly representative unless taken out on this basis. On the other hand, it is interesting to know the production of what may be termed the average normal cow, or, in other words, the average production

Table 8.—Average Production for Associations conducted by Officers of the Dairy Division, comparing Difference in Production between Results of Summaries compiled on the Basis of all Cows in Milk 100 Days or more and 210 Days or more.

Year.	100 Days or more.		210 Days or more.	
	Average Days.	Average Butterfat.	Average Days.	Average Butterfat.
		lb.		lb.
1925–26	218	221·19	257	259·20
1926–27	236	247·35	262	273·36
1927–28	229	246·91	264	282·54
1928–29	242	264·77	268	291·89
1929–30	250	278·59	269	300·20

of cows milking a normal number of days. In this table, for 1929–30 there were 4,388 cows in the 100-days-or-more classification, and 3,534 of these qualified for the 210-days section. The outstanding feature of the table obviously lies in the rapid upward trend of the average days in milk for the 100-days-or-more cows. Naturally, average production has increased in proportion to the lengthening of the lactation. In 1925–26 there were thirty-nine days between the two periods, whereas last year the difference was only nineteen days. It is also apparent that our increased average milking period has come about by the elimination of the short-distance milkers, the trend being distinctly toward a more standardized lactation.

Table 9 enables a comparison to be made of average butterfat-production according to land districts, four seasons being shown for purposes of comparison. This table is interesting, but to be of the maximum value must be read with an understanding of conditions obtaining in the various districts. Without a knowledge of details concerning classes of land, land-values, climate, dairy-farming conditions, and other matters which influence the subject the bare figures may not be appraised at their true value.

Table 9.—Average Production, according to Land Districts, &c., of all Cows under Herd-test for which Effective Seasons' Summaries were obtained. (Basis : 100 Days or over.)

Land District, &c.	1926–27.			1927–28.			1928–29.			1929–30.		
	Cows in Summary.	Average Days in Milk.	Average Butterfat.	Cows in Summary.	Average Days in Milk.	Average Butterfat.	Cows in Summary.	Average Days in Milk.	Average Butterfat.	Cows in Summary.	Average Days in Milk.	Average Butterfat.
			lb.			lb.			lb.			lb.
North Auckland	21,471	224	232·46	36,395	211	191·66	45,735	234	222·87	55,458	245	241·15
Auckland	78,625	240	244·82	95,799	235	225·04	102,239	247	238·27	106,549	256	260·27
Gisborne	2,405	217	218·08	5,244	231	234·39	9,045	233	230·45	11,606	236	234·62
Hawke's Bay	2,285	230	208·95	4,107	230	233·72	7,705	243	249·61	8,281	221	258·06
Taranaki	12,857	241	239·67	22,180	238	247·01	28,515	249	259·76	30,366	254	271·59
Wellington	25,400	258	256·53	29,300	233	244·89	34,524	243	257·93	40,343	242	246·80
North Island ..	143,043	240	252·29	193,025	230	224·72	227,763	243	240·92	252,603	249	254·03
Nelson	261	233	239·27	341	154	162·44	936	203	237·00	1,976	225	255·15
Marlborough	..	..	..	..	..	..	1,956	217	244·84	3,417	224	250·76
Westland	..	..	..	..	..	..	..	..	..	..	..	..
Canterbury	3,917	207	219·03	2,847	226	222·57	3,081	218	237·67	2,506	206	237·65
Otago	820	199	247·02	720	239	273·42	552	219	253·99	2,790	227	244·41
Southland	6,987	217	215·36	9,390	220	222·94	11,523	225	231·89	9,262	227	249·92
South Island ..	11,985	213	219·06	13,298	221	224·04	18,048	222	235·22	19,951	224	248·27
Dominion	155,028	238	240·48	206,323	230	224·68	245,811	242	240·50	272,554	247	253·61

Table 10.—Distribution of Records for all Tested Cows in the Dominion represented in Effective Annual Summaries received, Seasons 1928–29 and 1929–30. (Basis : 100 Days or over.)

System.	Class Limits (in Pounds of Butterfat).																	Total Number of Cows classified.
	Under 50.	50–100.	100–150.	150–200.	200–250.	250–300.	300–350.	350–400.	400–450.	450–500.	500–550.	550–600.	600–650.	650–700.	700–750.	750–800.	800–850.	850–900.	
1928–29.																			
							Numbers.												
Association	32	1,132	4,780	8,075	9,414	7,830	4,883	2,363	843	265	79	17	6	2	1	..	..	..	39,722
Group ..	468	5,384	17,993	38,032	51,229	45,775	28,341	12,811	4,440	1,230	299	67	15	2	..	2	..	1	206,089
Both ..	500	6,516	22,773	46,107	60,643	53,605	33,224	15,174	5,283	1,495	378	84	21	4	1	2	..	1	245,811
							Percentages.												
Association	0·08	2·85	12·03	20·33	23·70	19·71	12·29	5·95	2·12	0·67	0·20	0·04	0·02	*	*	..	..	..	39,722
Group ..	0·23	2·61	8·73	18·45	24·86	22·21	13·75	6·22	2·15	0·60	0·14	0·03	0·01	*	..	*	..	*	206,089
Both ..	0·20	2·65	9·26	18·76	24·67	21·81	13·52	6·17	2·15	0·61	0·15	0·03	0·01	*	*	*	..	*	245,811
1929–30.																			
							Numbers.												
Association	24	841	3,526	6,378	7,993	7,289	5,300	2,634	1,149	343	106	20	10	..	..	..	..	..	35,613
Group ..	697	5,485	17,811	37,749	54,712	54,056	37,587	18,883	7,088	2,108	584	134	38	6	2	..	..	1	236,941
Both ..	721	6,326	21,337	44,127	62,705	61,345	42,887	21,517	8,237	2,451	690	154	48	6	2	..	..	1	272,554
							Percentages.												
Association	0·07	2·36	9·90	17·91	22·44	20·47	14·88	7·40	3·23	0·96	0·30	0·06	0·02	..	..	..	..	..	35,613
Group ..	0·29	2·31	7·52	15·93	23·09	22·81	15·86	7·97	2·99	0·89	0·25	0·06	0·02	*	*	..	..	*	236,941
Both ..	0·26	2·32	7·83	16·19	23·01	22·51	15·73	7·89	3·02	0·90	0·25	0·06	0·02	*	*	..	..	*	272,554

* Data occurring, but relatively insignificant.

Table 10 has been compiled for the purpose of illustrating the difference in distribution of records for the Group and Association systems. As would be expected from the gradual advance in average production, each year shows a higher percentage of the total records in those classes which include performances of from 200 to 350 lb. butterfat. One must naturally look for slight out-of-step fluctuations in those classes which are more sparsely represented, and a table which covers only two seasons allows little scope for comment. Were it possible to include the past five or preferably ten years the position would be more clearly demonstrated.

Table 11 is similar to Table 10, except that it is compiled on the 210-day basis, and includes only cows tested under the Association system. Herd averages as well as individual cow averages have been taken into consideration. The remarks on Table 10 also apply to Table 11.

Table 11.—Percentage Distribution of Records and Herd Averages in Organizations controlled by Dairy Division, Season 1929–30.

Basis.	Class Limits (in Pounds of Butterfat).													Total Number classified.
	Under 50	50–100	100–150	150–200	200–250	250–300	300–350	350–400	400–450	450–500	500–550	550–600	600–650	650–700	
Records.															Cows.
100 days and over	0·04	1·30	4·56	11·42	20·39	22·90	19·99	12·03	5·13	1·50	0·57	0·14	0·02	..	4,388
210 days and over	..	..	0·90	6·42	19·13	25·55	24·05	14·80	6·36	1·87	0·71	0·17	0·03	..	3,534
Herd Averages.															Herds.
100 days and over	..	0·39	4·67	11·28	19·07	28·40	22·57	11·67	1·55	0·39	..	..	..	..	257
210 days and over	..	..	..	1·41	14·55	36·15	27·23	17·84	2·34	0·47	..	..	..	..	213

Fig. 2 is based on the data supplied by Table 10, and should be studied in conjunction with that table. The figure indicates graphically the percentage frequency of records appearing in the various classes as marked along its base. By "percentage frequency of records" is meant the percentage of the total number of records represented by the number of records which fall within the limits of production within each butterfat-production class specified along the base line of the graph. The two seasons 1925-26 and 1929–30 are represented. The advancement of the modal point—that is to say, the moving-forward toward the higher-production class—is readily apparent, and demonstrates quite clearly the diminishing proportion of lower-producing individuals. The graph has not been continued beyond the 550–600 lb. butterfat division, as from that point onward the percentages are too small to have any important bearing on the general position.

Calf-marking.

An adjunct of herd-testing which is receiving considerable support in some districts is the scheme commonly known as calf-marking. Under this scheme heifer calves from registered purebred sires are

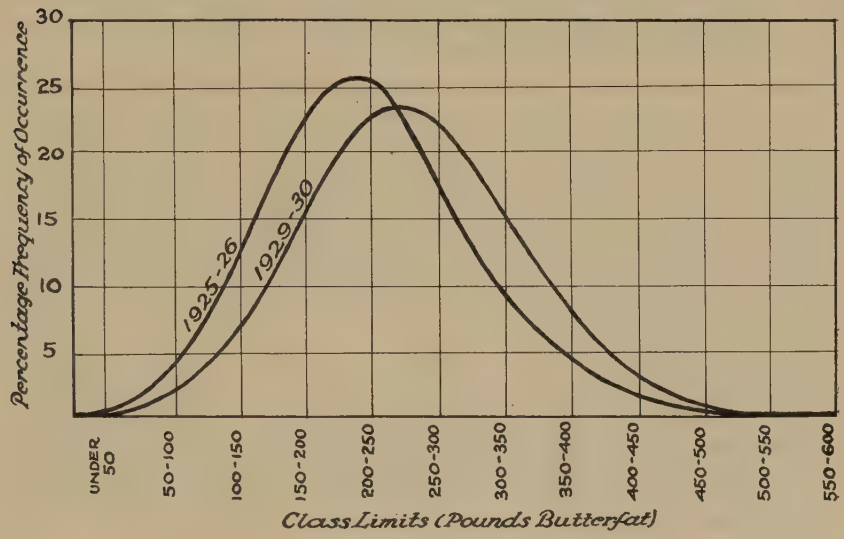

FIG. 2. PERCENTAGE FREQUENCY DISTRIBUTION OF RECORDS FOR ALL TESTED COWS REPRESENTED IN EFFECTIVE ANNUAL SUMMARIES RECEIVED FOR SEASONS 1925–26 AND 1929-30. (BASIS: IN MILK 100 DAYS AND OVER.)

marked by means of an individual and permanent identification tattoo in the ear, it being necessary for the dam to have produced under Group test a certain minimum butterfat requirement according to age. Calf-marking was first linked up with herd-testing by the New Zealand Co-operative Herd-testing Association (Inc.) some five years ago, and the system has extended rapidly. Some 641 calves were marked in the first season while last year's number was over 12,000

Two years ago the Dominion Group Herd-testing Federation (Inc.), which now controls the calf-marking work, extended the system to bull calves. With bull calves both sire and dam must be registered purebred animals, and, in addition, the dam must have been tested by an association affiliated with the Dominion Group Herd-testing Federation. Minimum butterfat requirements according to age apply as in the case of the heifer calves, the standards being slightly higher for the marking of bull calves.

Conclusion.

Taking a final glance at the herd-testing movement in New Zealand as it stands at the close of the 1929–30 dairying year, it is apparent that the workers in this branch of activity have reason to be proud of the position. The foundation is well laid for considerable extension, and it would seem that we are justified in expecting still higher figures by way of yield and number of tested cows for some years to come.

The sum of £10,500 has recently been paid over by the Government as a subsidy on the past season's herd-testing, the major portion of

this amount having been distributed among testing dairy-herd owners. A sum of £8,000 has been granted by way of assistance to herd-testing carried out during the current season, 1930–31.

Apart from providing owners with data relating to the productive ability of their cows, herd-testing is playing an important part from the educational point of view, and in this direction calf-marking is doing its share. There is doubtless more attention paid each year to the matters of pedigree, herd-building, mating, and culling, and this sphere of the dairy-farmer's business cannot be conducted with the maximum of efficiency without the completeness of knowledge provided by an unbroken chain of butterfat records. The educational side is one in which there is scope for extension, and it could profitably be given closer attention in future.

A noticeable feature of herd-testing in New Zealand is its comparatively reasonable cost. This is very important. Herd-testing is only one of the avenues through which the dairy-farmer is required to expend money, and it is only one factor in successful dairy-farming. Care must be taken not to overstress the relative importance of the subject. Herd-testing will not in itself improve the herd, but it supplies that information which is essential for systematic herd-improvement.

COST OF MOLE DRAINAGE.

SEVERAL inquiries have been received from farmers regarding the cost of mole drainage. Reliable local data are supplied by Mr. W. J. McCulloch, Fields Superintendent, Department of Agriculture, who kept cost accounts respecting the drainage a year or two ago of an area of 35 acres on the Massey Agricultural College farm, when he was acting as farm-manager to that institution. The haulage was done by a tractor, and the costs were computed as follows :—

	£	s.	d.
Driving and other labour—50 hours at 1s. 10½d. per hour	4	13	9
Benzine—54 gallons at 1s. 6¼d. per gallon	4	17	4
Oil	1	4	0
Interest repairs, and depreciation on a £400 tractor at 2s. 6d. per hour ..	6	5	0
Total	£17	0	1

On the basis of these figures the cost of the drainage works out at 9s. 8½d. per acre.

It should be mentioned that in this job the drains were drawn 6 ft. apart instead of the usual 9 ft. spacing, so that the work done was 50 per cent. more than in the mole drainage ordinarily carried out.

Compensation paid for Stock and Meat condemned.—Compensation to the amount of £18,183 0s. 6d. was paid out during the official year 1929–30 for animals condemned in the field for disease under the provisions of the Stock Act; and £13,383 19s. 6d. for carcasses or parts of carcasses condemned for disease on examination at the time of slaughter at abattoirs, meat-export slaughterhouses, &c., under the provisions of the Slaughtering and Inspection Act.

WINTER FEEDING OF STORE PIGS.

CO-OPERATIVE TRIALS WITH ROOTS AND MEAT-MEAL.

K. W. GORRINGE, Instructor in Swine Husbandry, Live-stock Division.

IT is often remarked in connection with pig-raising that the sow is the main factor on which depends success or failure. This statement is correct up to a certain point, but it must be recognized that the breeder assumes part control from the time the piglets are three weeks of age up to weaning-time, and from then on takes over sole control of the weaners until they arrive at the pork or bacon stages. Many farmers realize the importance of having well-bred animals in the parent stock, and with judgment in feeding and management secure two litters per year of strong, healthy pigs. The spring litter has always been considered the easier and more profitable of the two, for with a plentiful supply of skim milk and whey, together with rich spring pasture, supplemented with meal or grain, good porkers or baconers can be readily produced. It is the autumn litter which has generally been a source of worry and disappointment, in view of the fact that the litters have to go through a winter store period with its harder conditions and cost.

A quite common method of winter feeding adopted is to give roots of some kind frequently without any supplement in the form of meals or grain, with the result that large numbers of the pigs die before the spring arrives, while those which survive are usually of such a stunted and unthrifty nature that extra time, labour, and food are entailed before they arrive at the porker or bacon weights, resulting in an unprofitable finish.

As referred to in some preliminary notes published in last month's *Journal*, the advent of meat-meal as a stock-food has now greatly changed the outlook in pig-raising, especially as regards winter feeding. Following on an experiment at Lincoln College with mangels and meat-meal, the Department of Agriculture decided to institute a number of feeding trials on farms with meat-meal and any root crop that the farmer had at his command. During the past winter these trials have been conducted on fifteen farms, the owners carrying out the instructions of the Department and the Department in turn providing a portion of the meat-meal and performing the necessary weighing and supervision. The trials commenced at the beginning of June and ended about the middle of August.

The conditions under which the farmers co-operated were as follows: (1) The feeding to continue for seventy-five days, and the pigs to be weighed at the end of fifty days and at the completion of the trial; (2) from ten to twenty pigs to be supplied; (3) provision of a suitable separate paddock, a clean warm house (but nothing elaborate), with fresh water and as many roots as the pigs could consume daily, together with ½ lb. meat-meal per pig per day, to be fed dry in an open shallow trough. These directions were quite simple and capable of being carried out by any farmer. All pigs were out

in the open during the day and in every sort of weather, which at times was severe. Eleven lots were fed mangels, five with swedes, and one with chou moellier.

At the first weighing—after fifty days—a remarkable change was shown in the pigs generally. With increased vigour, bright clean skins and shiny coats, and well-rounded bodies, they closely resembled animals that had been stied and well fed. From observation, the Berkshire-Tamworth cross pigs appeared to be thriving better than the other types, except in one case where Berkshires did very well, considering they were the youngest pigs in the test.

The following table gives particulars of the trials :—

Table 1.—Co-operative Trials on Winter Feeding of Pigs.

Owner.	Number of Pigs.	Breed.	Roots.	Average Weight at Commencement of Test.	Average Weight after Seventy-five Days.	Total Increase per Pig.	Increase per Day.
				lb.	lb.	lb.	lb.
E. Nicholson, Hawera ..	8	Tamworth Cross	Mangels ..	47·0	107·4	60·4	0·80
J. C. Gardner, Levin ..	9	Tamworth Cross	Mangels ..	68·3	125·2	56·9	0·76
A. Saville, Tamahere ..	20	Tamworth Cross	Mangels ..	45·1	100·7	55·3	0·74
D. Kernohan, Koputoroa* ..	20	Tamworth Cross, Large Black Cross, Large White Cross	Mangels ..	63·1	106·9	43·8	0·58
F. Smith, New Plymouth ..	10	Tamworth Cross	Swedes ..	61·0	103·4	42 4	0·56
C. Zabell, Carterton ..	10	Berkshire ..	Swedes ..	26·7	68·3	41·6	0·55
W. J Willis, Manakau ..	10	Tamworth Cross	Mangels ..	31·1	70·5	39·4	0·52
A. A. Dick, Blenheim ..	14	Berkshire, Large Black Cross	Mangels ..	27·8	66·1	38·3	0·51
Hikurangi College, Carterton	21	Tamworth Cross and Tamworth	Swedes ..	42·0	78·4	36·4	0·48
F. W. Parker, Blenheim ..	10	Berkshire and Middle White	Mangels ..	60·0	94·1	34·1	0·45
F. Smith, New Plymouth ..	10	Tamworth Cross	Chou moellier	61·1	92·4	31·3	0·42
A. Langkilde, Otorohanga†	20	Tamworth Cross	Mangels ..	59·8	86·6	26·8	0·35
E. Nickolson, Hawera ..	20	Berkshire ..	Mangels ..	28·0	54·5	26·5	0·35
J. Nunn, Carterton ..	16	Berkshire ..	Swedes ..	45·1	69·4	24·3	0·33
Stoddart Bros., Manaia* ..	20	Tamworth Cross and Large White Cross	Mangels ..	48·4	72·4	24·0	0·32
A. H. Elkins, Carterton ..	22	Large White Cross	Swedes and soft turnips	36·2	58·3	22·1	0·30

* One pig died. † Two pigs died.

In addition, there was one other trial, on the farm of Mr. R. Oppenshaw, Lepperton, that was carried on only for fifty days, during which the average daily gain was 0·55 lb.

The original experiment conducted at Lincoln College, calculated on the same basis as the Department's co-operative trials, works out as follows, the roots used being mangels: Average individual weight, 66·4 lb.; average weight after seventy-five days, 104·7 lb.; total increase per pig, 38·3 lb.; increase per day, 0·51 lb.

Notes on the Results.

Average Gains.—As was to be expected, there was a considerable range in the average gains, varying from 0·8 lb. per day down to 0·3 lb., giving an average of 0·5 lb. These results can be viewed as highly satisfactory, and even in the cases where comparatively small gains have been recorded the farmers concerned are fully satisfied that with quite moderate feeding of meat-meal the carrying-through of pigs on roots is a decided success.

Mortality.—Up to the present time a feature in the wintering of young pigs on roots alone has been the high death-rate that usually occurs. All the farmers co-operating in these trials complained about their previous winter losses, and the low death-rate among the 260-odd pigs under trial—amounting to 1·9 per cent.—is of very special significance. Even in those cases where the lowest increases in weight were recorded the animals came through the winter with bright clean skins and shiny coats.

Quantity of Roots consumed.—It was not found possible to get an exact record of the quantities of roots consumed, nor is this of really very great importance. Experience has amply shown that young pigs when wintered on roots alone suffer a very high mortality and on the average do very badly. The definite object of these trials was to prove whether or not small quantities of meat-meal under ordinary farming practice would make root-feeding effective and profitable.

It is estimated that the quantity of mangels consumed per day per pig varied from 6 lb. to 16 lb., the higher weights consuming somewhere about the latter figure. This is in very close agreement with figures supplied by Mr. W. J. Scott regarding the original experiment at Lincoln College, in which pigs of an initial weight of 66·4 lb. consumed 15 lb. of mangels per day over the sixty-three-day period the trial lasted.

In the ten trials recorded in the table where mangels were fed the average daily increase in weight of the pigs was 0·54 lb. Estimating that on the average of 12 lb. of mangels per day were consumed, on these figures 1 ton of mangels and 93 lb. of meat-meal will produce 100 lb. of live-weight increase. With pork at 6d. per pound, 1 lb. live-weight would be worth 4d., and deducting the cost of the meat-meal at $1\frac{1}{4}$d. per pound there would be a return of £1 3s. 6d. for each ton of mangels consumed. Put in another way, the result of these trials indicates that 1 lb. of meat-meal fed in conjunction with mangels will produce on the average not less than 1 lb. live-weight increase, or a gross return of very nearly 4s. for every shilling spent on meat-meal.

In the case of the five trials where swedes were fed, the average increase was less than with mangels, being 0·44 lb. per day as against 0·54 lb. per day. This was probably due very largely to the fact that in three cases the supply of swedes was inadequate. In the two other trials, where there was an abundance of swedes, a daily gain of 0·55 lb. was recorded. On the small dairy-farm, however, mangels are naturally the main root-crop that may be available for the wintering of pigs, and the question whether swedes or mangels are preferable will not in general come into consideration.

General. — Some of the tests proved specially interesting — for example, that on the farm of Mr. A. A. Dick, Blenheim. Although breeding his own pigs, Mr. Dick did not have any fit for the testing, as they had all been sold before the winter on account of previous unsatisfactory wintering and high mortality experienced. He therefore purchased two litters at a sale from different owners. Taking the eight best weights at the start, which ranged from 28 lb. to 32 lb., and the six lowest weights, ranging from 25 lb. to 27 lb., the former lot produced an average increase of 47 lb. in seventy-five days, whereas the latter only produced 27½ lb. From the commencement the latter pigs did not show as much vigour as the former, and probably were subject to worm trouble, which in itself would be sufficient to influence the lower production. Owing to the tender age of these pigs the full ration of meat meal was not fed to begin with, one-third only being used and two-thirds for the finish.

Mr. R. Oppenshaw, Lepperton, purchased a very mixed line of stores, some in very poor condition. At the end of fifty days' feeding a remarkable change had taken place in the pigs, most of which were then fit for pork, and so good were they that the owner asked to be excused from feeding any longer in the test, as he wished to kill some at once for pork. He was a butcher by trade and recognized their good condition. One pig increased 58 lb. in fifty days.

A comparison trial between swedes and chou moellier conducted by Mr. F. Smith, of New Plymouth, is worth noting. In separate paddocks ten pigs weighing a total of 610 lb. were fed with swedes, and ten others weighing 611 lb. with chou moellier. Those fed on swedes put on 42 lb. each, and those on chou moellier 31 lb. The difference here, as also in the case of Mr. Nicholson's two lots, may have been due more to the type of pig than to the feed.

The fact that some pigs showed small returns in the final weighing was due to a shortage of roots. This is especially noticeable in the case of Hikurangi College, which put up a good performance of 27·4 lb. in the weighings for the first fifty days and then dropped to 9·5 lb. in the last twenty-five days.

It is needless to comment on the remainder of the trials, as the figures show that they were highly satisfactory. Individual farmers have expressed their thanks to the Department for giving them the opportunity to carry out these tests in such a simple manner, and are highly pleased with the results obtained. In the case of two or three farmers it was the factor in deciding whether or not they would in future carry their pigs through the winter, and it is pleasing to note that they have all now agreed, in view of the good margin of profit shown over their winter operations and the excellent beginning under spring conditions, to carry on their pigs to heavier pork or bacon weights.

Owing to the wide area over which the tests were conducted it was not possible for the writer to personally obtain all the data, and he desires to express his thanks to Messrs. J. G. Scott, B. Grant, H. E. Allen, J. D. Anderson, H. R. Denize, F. W. Sutton, T. L. Morris, and W. G. Bonner, Stock Inspectors in the various districts, who assisted in the weighings.

FEEDING ENSILAGE TO SHEEP.

FARMERS' EXPERIENCES IN PAST WINTER.

Fields Division.

On many sheep-farms, because of economic considerations, total carrying-capacity is limited by winter carrying-capacity. Practically, the minimum carrying-capacity tends to become also the maximum carrying-capacity. This is because it does not prove financially attractive to purchase extra stock when winter is over, even though there is on hand sufficient feed to meet adequately the needs of such extra stock. If such stock were purchased in the spring they would be bought on a strong market, and a corresponding sale would be necessary in the following autumn on a usually weak market. Buying on a strong and selling on a weak market seldom proves satisfactory. Hence sheep-farmers should welcome any practice that would enable them to so increase their stocking as to be able to better use the spring and summer growth without being obliged to sell off regularly on a weak autumn market. Ensilage is a practice which promises to do this under many conditions.

While the use of ensilage in this connection is of interest to sheep-farmers generally, it is of special interest to many of those who are contemplating an extension of their grassland top-dressing programme. It has been laid down, as the result of experience both in New Zealand and overseas, that the best accompaniment of top-dressing is close grazing. From this it follows that if top-dressing is carried out and the resultant extra growth is not fully utilized, then the greatest possible financial returns from it are not being realized. Suitable ensilage measures provide a surety that top-dressing and desirably close grazing may be made to accompany each other, whereas top-dressing without ensilage may bring about uncontrolled summer growth of pastures—a position unwelcome not only as regards the welfare of the pasture, but also as regards the nutrition of sheep and especially of lambs.

Under many circumstances the date at which top-dressing is carried out will materially affect the amount of ensilage necessary. Usually top-dressing done in the late summer or autumn (as against winter or early spring) will result in increased winter and early spring grass-growth, and so less silage will be required to tide the flock over this critical period.

With a fuller appreciation of the value of grass utilization by sheep-farmers the question of carrying sufficient stock during the period of shortage becomes a very important factor in farm-management. In some cases the necessary provision is made by growing root-crops and the saving of hay—both very important where conditions are suitable—but on most farms with sufficient level land to enable the mower to be used there is no doubt that as its value becomes better known ensilage will be the main factor in the provision of this extra fodder.

Experiences from various Districts.

In the *Journal* for April last the experiences of several farmers in the feeding of silage to sheep were given. Since then, the experiences

of a number of others during the past winter have been gathered by officers of the Department, and are now related, as follows :—

WAIKATO.

Whewell Bros., Matangi.—This farm is 400 acres and was carrying dry dairy-stock and sheep—chiefly breeding-ewes for fat lambs. Messrs. Whewell Bros. fed silage to 600 aged ewes. These sheep were confined to 45 acres of pasture, the feed on which was almost negligible. Some hay was fed out, but ensilage was mainly depended upon. The ewes were carried through lambing-time till 1st September, when they were changed to a fresh clean paddock and the silage discontinued after seven weeks. This mob took about eight days getting accustomed to the supplementary feed. The ensilage was more suited for cattle, but the ewes held their condition very well, and lambed satisfactorily with a good supply of milk. No scouring occurred, and only one ewe had bearing-down trouble. The ensilage used was cut from a 10-acre paddock. Messrs. Whewell Bros. are very well satisfied with the experiment. They intend to make more suitable ensilage for sheep next season, and to increase their next winter carrying-capacity considerably.

W. B. Walker, Kihikihi.—The mob of sheep on this property consisted of 500 breeding-ewes—two-tooth to full mouth. These sheep were held on 25 acres and fed with ensilage for nine weeks, till 14th August, when they were given a change and the silage discontinued. The ewes were entirely dependent on the supplementary feed. As in the case of Messrs. Whewell, the sheep were in good store condition to commence with, and this was maintained without the least set-back. In this instance the ewes were about eight days before getting accustomed to the new forage. Over 100 per cent. of sturdy lambs have been docked, so that the feeding of silage has been a decided success. No bearing-down trouble was experienced, and only two deaths occurred. The silage stack from which the sheep were fed was two years old, and, although good, it was not of a kind ideal for sheep. About 500 acres of Mr. Walker's farm are in grass, and on this, with the addition of silage, he wintered 1,850 ewes, 250 hoggets, 40 rams, 150 cattle, and 20 horses. The silage from 14 acres enabled the carrying of 400 extra ewes. Next winter the carrying-capacity will be increased by five or six hundred sheep. It may be mentioned that the horses were also fed on ensilage and kept their condition.

E. C. Houchen, Ohaupo Road.—On Mr. Houchen's farm silage was fed to 450 aged ewes in rather low condition. They were allowed the run of 30 acres, subdivided into three paddocks. Ensilage was fed to them, generally twice daily, with about three feeds of hay weekly. The feeding of silage commenced on 12th June and continued till 31st July. During this period it is estimated that the ewes consumed 48 tons of ensilage, or the product of 8 acres. As in the two previous cases, the silage was much more suitable for cattle than sheep. Owing to the condition of the ewes this experiment has been a very severe test, and yet the lambs are well nourished and doing well. In this case twelve deaths of ewes occurred. The extra carrying-capacity in the past winter is estimated at 300. Next winter, with more suitable ensilage, it is intended to double the number. Next year Mr. Houchen purposes varying his methods of feeding somewhat by giving the sheep more change of pasture. Ensilage will not be given until the pasture is eaten out after each change.

I. R. K., Korokonui.—In this case ewes were being fed on turnips. Ensilage was also being carted out to cattle in an adjoining paddock. I. R. K. noticed that his neighbour was feeding out ensilage to his ewes

and decided to try it with his own as a matter of curiosity. To his astonishment the ewes immediately left the turnips and took to eating the silage without hesitation.

TARANAKI.

H. Barr, Scott Road, Hawera.—The number of sheep fed with ensilage was 1,100, commencing the first week in May. It was found that there was no difficulty in inducing the sheep to take the ensilage at the start. None of the sheep had been previously fed on ensilage, but were used to being fed on forage crops. The ensilage was from a stack made from lucerne and Western Wolths rye-grass. The colour was good, being of light brown in most of the stack; the top portion was a little dark due to overheating; and the last 6 in. at the bottom was greenish and slightly sour. The last two types—the overheated and the slightly sour—the sheep did not like so well as the light-brown sweet material. It was found, on the other hand, that the cows would take the slightly sour material in preference

FIG. 1. SHEEP KEEN FOR ENSILAGE ON A TARANAKI FARM.

to the other. There was no salt used in the making. The amount fed was judged by what the sheep would eat. If any was left over then the next day's amount was reduced. The ewes were about five years old. The ewes would line up along the fence every morning waiting for the cart to come over from the stack, and they would follow it round while the ensilage was being spread.

S. Topless, Urenui, and A. Turnbull, Huirangi.—Both these farmers consider the feeding of silage to sheep has been very successful, and have fed in-lamb ewes continuously from June to September. Each year some little difficulty is experienced in inducing young sheep to commence eating silage, but once they have started eating it no further trouble is experienced. The method of starting is to hold the sheep in a small paddock for a day or two until they are hungry and then feed ensilage to them. Mr. Turnbull considers that his ewes show a great preference for and do much better on silage made from grass cut in the young stage.

Hawke's Bay.

Rosslyn H. Tod, Otane.—Mr. Tod writes as follows: "I have been feeding ensilage to sheep in winter for four years, with satisfactory results. The carrying-capacity of a farm can be increased by about 20 to 40 per cent. in a flock of, say, 2,000, where a stand of lucerne is used and converted into ensilage. In a normal season grown sheep thrive when ensilage is fed to help out the pasture in winter after they have acquired the taste for it. Ensilage for sheep must be of good quality—cattle are not so particular about quality, and eat anything. Hoggets are much more fastidious than grown sheep, and discriminate at once between the sweet-smelling brown ensilage and the green sour-smelling stuff—they prefer the latter. Hoggets take longer to acquire the taste, and therefore suffer more in the learning if the pasture is poor. If ensilage-feeding is adopted as part of a farming system it is a good idea to train the hoggets to eat a little, as it saves trouble and waste if in later years they come under the system of an ensilage ration. I fed ensilage to ewes in lamb this year. They had never known artificial feed of any description before, and as the pasture was rather poor on account of the drought, which extended right into the winter in Hawke's Bay this year, they suffered considerably in condition before acquiring the taste. They did better later and cleaned up all that was given to them, but will not get back the condition they lost and are still showing the effects at lambing (the critical time). There were 640 in this mob of ewes—their ages ranging from two-tooth to eight-tooth—and the ration was approximately 5 lb. per head per day. In my experience ensilage for sheep is a success. I would not say that it compares with a crop of roots, but it is easier won. It feeds well with roots. All this ensilage was made out of lucerne."

C. Rosser, Pakipaki.—Area of farm, 271 acres. Good-quality land, all on flat. Of supplementary crops in the past winter, Mr. Rosser had 10 acres of mangels, and 65 acres of autumn-sown young grass had not been grazed by the middle of August. The stock wintered was 1,900 hoggets, 200 breeding-ewes, about eighty dairy cows, and forty dry cattle, horses, &c. At mid-August the ensilage stacks were nearly finished. There were three stacks about 36 ft. by 18 ft. by 8 ft. high, and the ensilage was made from grass, the quality of which was quite good. The scene when Mr. Rosser was feeding one lot of hoggets was a remarkable one. The hoggets left the mangels which had been spread in the paddock, and ran from all directions to meet the motor-lorry with the ensilage. These hoggets ate the ensilage ravenously and appeared to be in fine condition. Two hundred breeding-ewes in a paddock of 4 acres, and which were lambing, looked well, and were living entirely on ensilage. It should be mentioned that the two paddocks the hoggets were in had stacks of threshed rye-grass in them, but this was not being eaten much and was probably more useful as shelter. Mr. Rosser states that it takes about ten days for sheep to take to ensilage properly, but there is no doubt they eventually become extremely fond of it. He started feeding ensilage in the beginning of May, and used it for all classes of stock.

Estate of W. Van Asch, Craigie Range, Tukituki.—On this property one paddock of 48 acres carried 1,500 four-tooth Romney-cross wethers, and a second paddock of 115 acres had 2,600 four-tooth wethers. Large quantities of very good ensilage were carted out daily to both lots of sheep, and it was a most impressive sight to see these large mobs flock round the wagon, running from all directions and pulling the ensilage off the wagon. The sheep were fed ensilage from 25th June onwards, and kept in good store condition. It should be mentioned that these 4,000 wethers were being fed for two outside owners at 3d. per head per week until sufficient spring growth of grass arrived. Mr. Van Asch, jun., calculated that he was

FIG. 2. MAKING CUT THROUGH A RIDGE FOR ENSILAGE TRENCH ON THE VAN ASCH ESTATE, HAWKE'S BAY.

FIG. 3. LOADING ENSILAGE FOR FEEDING OUT TO SHEEP, VAN ASCH ESTATE.
This view also shows the method used for finishing the construction of the trench.

feeding about 4 lb. per head per day. Here, also, it was stated that it takes eight to ten days' starving to induce sheep to acquire a taste for ensilage, and both Mr. Rosser and Mr. Van Asch suggest that it would be better to yard the sheep for three days or so and get over the difficulty more quickly. It is also agreed that sheep should be taught to eat it while they are still in good condition, and not after they have been allowed to become more or less poor. The total deaths up to mid-August among the 4,100 wethers were only six. One pit alone on Mr. Van Asch's farm is computed to contain 600 tons of ensilage. The measurements are over 90 ft. long, 25 ft. wide, and 22 ft. deep. This, it is understood, took three weeks to make with a tractor and automatic scoop, team ploughing, and one man on the batters.

W. Stokes, Tikokino.—In this instance the sheep were 300 stud Romneys. They were very stubborn in commencing to take the ensilage, but became very keen indeed after acquiring the taste. In fact, they became so keen and put on condition so quickly that for a short time the ensilage had to be discontinued. On a reduced ration this stud flock has been satisfactorily carried through the past winter.

Thompson Bros., Ngatarawa.—These farmers have been feeding ensilage to sheep successfully for several years. Their farm consists of 433 acres, and its carrying-capacity is approximately 3,000 sheep. The silage, which is made of lucerne principally, is saved in pits. This year feeding extended from 16th March to 16th April, and from 3 lb. to 4 lb. per head daily was fed together with some hay. Messrs. Thompson, believing that a change of feed is advisable, provide silage in the morning and hay at night. A remarkable feature of silage feeding to ewes, according to Messrs. Thompson, is that the troubles often accompanying lambing are practically non-existent among their breeding stock.

Wellington.

During 1930 the experiences on the farms of Dr. Paget, Waverley, Mr. R. Black, Karioi, and Mr. A. S. Brewster, Makino, Feilding, were on similar lines to those recorded in the April issue of the *Journal* in respect to the 1929 season.

Marlborough.

J. P. Donald, Havelock Suburban.—In this case grasses and clovers were made into ensilage in a pit in a hillside, approximately 50 tons being saved. The ensilage was fed to sheep in racks and on clippings of barberry hedge laid on the ground. The sheep went back in condition when hay was fed after the ensilage was finished.

Kennington Bros., Seddon.—On this farm the stack of ensilage, made from lucerne with a proportion of barley-grass, was of good quality. The sheep ate it readily, and one mob had very little else for six weeks, and put on condition. Cows preferred it to the best lucerne hay.

Canterbury.

A. Amos, Wakanui.—Mr. Amos started feeding out ensilage to sheep in June together with some turnips, and later fed ensilage alone at the rate of 2½ lb. per day. Four hundred hoggets, changed over from hay and turnips, put on quite a bloom after being on the ensilage alone for a fortnight. At the middle of September Mr. Amos was still feeding his ewes (with lambs) on ensilage, and was well satisfied with results.

E. S. Barnes, Coldstream.—Mr. Barnes fed his ensilage at the daily rate of 1¼ lb. per sheep, along with mangels. The ewes showed a decided preference for the ensilage.

Otago.

James Smith and Sons, Greenfield.—These farmers started feeding ensilage to 500 hoggets and 400 ewes early in June. The sheep were running in a

stubble paddock, so a square corner (about 2 acres) was fenced off and the sheep were shut in it and fed with ensilage—just a small quantity sprinkled with diluted molasses. At the end of the second day the ensilage could hardly be carted to them fast enough, so they were let out and fed in the paddock after that. They always met the dray at the gate and cleaned up all that was given them. The death-rate was very low. The ensilage gave out at the end of July, but the sheep seemed to hold their condition, and when put on young grass at the end of August they went right ahead. There were not many breeding ewes in that lot, but those that had ensilage finished lambing with less trouble and loss than previously experienced. Messrs. Smith intend to try and save more ensilage this season, as they are convinced it is much healthier than turnips. Their paddocks were covered with snow for a week in the winter, but the sheep did not go back at all, as they had a good feed of ensilage twice a day.

J. A. Anderson, Waiwera South.—Mr. Anderson's feeding of sheep with ensilage was made in conjunction with turnips. The sheep were put on turnips about 9 a.m., left on all day, put on a small run-off with ensilage in the evening, and left overnight. A rack made of sheep netting and staked, about 100 yards long, was used, also another feeder of sacking material supported by plain wire and staked, 8 yards in length, enabling between 700 and 800 sheep to feed at one time with comfort. Eleven hundred ewes were fed in this way, taking about 1½ lb. of ensilage per head per night, as well as as much turnips as they cared for during the day. The ewes were given ensilage for three weeks up till within a week of time due to start lambing. In the middle of September some 200 had lambed, and very little trouble had been encountered with either ewes or lambs.

Concluding Points.

By cutting surplus grass for ensilage farmers are enabled to preserve what would otherwise go to waste, and, what is also very important, they are enabled to keep their pastures short and in a very much better condition for sheep-feeding.

Another important point is that surplus grass for making ensilage, particularly for sheep, should be cut at the proper time—just when it is getting into bloom. If cut at this time the material is ideal, and the aftermath comes away rapidly. This is especially necessary for sheep-feeding, for while cattle will eat a poorer quality or an older and more stemmy ensilage, sheep do not care for it, and consequently do not do so well on it.

It may be reiterated that when there is a certain amount of grass available sheep will do well if given from 2 lb. to 3 lb. of ensilage per head per day, but where they have to depend practically on ensilage alone about 5 lb. per day should be provided.

The actual experiences of practical farmers recorded to date indicate that throughout New Zealand ensilage has been fed, in some instances for several years, to sheep of varying ages, with most satisfactory results. The recorded experiences indicate, further, that almost always there is some initial hesitation on the part of the sheep in commencing to consume the silage, but that once this hesitation has been overcome they eat it readily. This hesitation suggests the advisability of commencing the feeding of ensilage to sheep while they are still in good condition. The partial temporary starvation of sheep which are already in low condition might lead to harmful effects on the wool which would not arise from similar treatment of animals in good condition.

THE COOL STORAGE OF FRUIT.

R. SUTHERLAND, Cool Storage Officer, Horticulture Divison.

THE ORCHARDIST'S PART.

HAVING produced a first-quality product for cool storage, the fruit-grower must bear in mind during harvesting the delicate nature of the fruit, and handle it accordingly. Any injury will result in early deterioration in storage; therefore, in order to obtain the maximum results, care must be exercised during picking, transport, grading, and handling generally.

When the fruit is removed from the tree it should be placed in the picking receptacle carefully. The receptacle should be firm, so that when placed in it there will not be any danger of the fruit being damaged as the picker moves about the tree. The fruit should be placed carefully in the cases and these stood on the side of the trees that will be shaded for the longest period during the day. It is of considerable advantage, when the weather is hot, for the fruit which is picked during the afternoon to be left in the orchard overnight and forwarded to the grader the next morning while it is still cool, as less injury is liable to occur when the fruit is graded while comparatively cool.

If the fruit is to be placed in a local cool store it is not necessary that it should be wrapped and packed, but only to paper-line the cases, placing the fruit in carefully and lapping the paper over the top, as it will cool rapidly when stored in this manner. The wrapping and packing can be carried out before forwarding to market, thus making sure that there is no damaged or decayed fruit in the case.

EFFICIENT STOWAGE.

The fruit should be forwarded to the cool store as soon as possible after picking, and stowed carefully in the chambers. The stacks must be uniform throughout, allowing at least ½ in. clear space round each case, and at least 12 in. between the top case and the ceiling of the chamber. This space is essential, no matter what system of temperature distribution is employed.

The cases of fruit should be stowed in such a manner that the greatest area of the case will be exposed in the direction of the air-flow, whether the cooling is by convection currents or forced-air circulation. As warm air naturally rises to the highest point in the compartment, the top cases of fruit are more likely to be exposed to a higher temperature than those lower down. By allowing free air-space over the top of the stacks, or making this position a line of least resistance, the warm air will be removed more rapidly than it would otherwise. If fruit ripens in a cool-storage chamber the top case is generally the ripest. This applies to most systems of distributing the refrigeration, with the exception of the method of delivering the refrigeration over the top of the fruit. By this system the coldest temperature is at the top, and as the cold air naturally falls more uniform temperature is maintained.

General Conditions of the Store.

As previously mentioned, very great care must be exercised in picking, packing, grading, &c. Injuries to the fruit occur that may not be visible at the time of storing, and it is possible that owing to these injuries a small proportion of fungal rots will occur, as the path of attack has been laid open for the spores of fungi which are on the fruit when it leaves the orchard. But assuming delivery to the store of fruit in good condition and free from disease or injury, the cool-storage management has also a duty to perform. The first essential is cleanliness of the establishment, both inside and outside the storage-rooms, and also around the main building. Any waste or rejected fruit must be removed immediately; empty cases, dirty papers, or accumulations of rubbish of any description should be avoided.

Uniform Temperatures during Loading.

The chambers and insulation should be thoroughly cooled before any fruit is placed in the storage-rooms. This can be more efficiently carried out when the rooms are empty, because the temperature can then be reduced to a very low degree. On the other hand, if fruit is stowed before the insulation is cooled, the process is somewhat slow, and for some considerable time it is more difficult to maintain a uniform temperature during the loading.

When loading of the rooms commences every endeavour must be made to maintain a uniform temperature suitable for the kind or variety of fruit being stored, and although this may be done it will be several days before the fruit is actually cooled. However, if during the day's loading there is a variation or rise in the temperature (which in most cases there will be) in proportion to the temperature and quantity of fruit loaded into the rooms, this variation or rise should not be greater than the refrigerating plant and equipment is capable of reducing and consolidating before the next day's loading commences.

If at the end of each week during loading the temperature of the rooms is at a uniform degree, advantage should be taken to consolidate this temperature, for, although the reading of the thermometer may show uniform temperatures, that of the fruit is very much higher. By the temperature of the fruit being consolidated during the week-end, a precaution is being taken to prevent any undue rise in the temperature of the fruit already cooled. If, however, this precaution is not taken and the refrigerating-plant is closed down, a considerable rise in temperature may take place. The result will be that when the next day's loading commences not only has this heat to be removed, but also the heat of the fruit loaded during the day. In addition, a large proportion of the commodity has still to be further reduced, and the heat generated by the fruit itself has also to be dealt with. In order to maintain uniform temperatures during the loading it is essential that the circulation of cold air be continuous over an extended period.

Ventilation and Humidity.

Adequate facilities are usually provided for ventilation cool-storage chambers. Although during loading the opening and closing of the

doors will give a certain measure of control, care must be taken to prevent the accumulation of carbonic acid or other gases evolved by the fruit.

During the loading of the fruit and its initial cooling a low relative humidity should be maintained, the regulation of which is effected by frosting and defrosting the pipes in either direct expansion or brine-pipe cooling, and by regulating the density of the calcium-chloride brine in the battery system. Defrosting the pipes dries the air, and in the battery system the moisture from the air will be absorbed by the brine. In order to absorb the moisture from the air chloride of calcium brine having a specific gravity of 1·189 (which will represent a reading of 92° by a Salometer and of 23° by Beaume) is necessary. When these readings are taken the brine must be at a temperature of 60° F., and must be either warmed up or cooled down to this temperature. It will not be long before the specific gravity of the brine decreases in proportion to the moisture absorbed, and it will be found necessary to evaporate the moisture in a concentrator. Although this high specific gravity is recommended during the initial cooling, it is not recommended that it be carried throughout the storage season, as brine of a specific gravity of 1·159 is suitable for all practical purposes.

Systems of Refrigeration.

There are in general use three principal systems of refrigerating cool stores: (1) Cold-air circulation or the battery method, (2) direct expansion, (3) brine circulation. To these may be added the dry-battery method with air circulation.

COLD-AIR CIRCULATION OR BATTERY METHOD.

The battery-room is usually erected at the end of the cool-storage building; it is constructed and insulated in a similar manner to the storage-chambers. At the bottom of this room a tank made of steel or 8 lb. sheet lead is fitted to hold the chloride of calcium brine. The battery consists of a nest of ammonia-expansion pipes. The air is drawn by a powerful fan over this battery of pipes, in which the ammonia is expanding, and over which the brine is kept flowing. The air in passing over the coils is cooled; its moisture and any impurities are absorbed by the brine. The air is then delivered into the storage-room sweet and clean.

The cooling-battery is in a separate compartment, and the temperature of the storage-room can be regulated by the opening or closing of the shutters which are fitted on the air-trunk. This being so, the battery-room and brine can be reduced to a very low temperature without the danger of it being too low in the storage-room. In this way reserve refrigeration can be stored, enabling the engineer to make preparation to receive a large consignment at any time. He can also divert a major portion of the cold air to one or more chambers, and at the same time maintain a uniform temperature in other rooms.

During the flush of the picking-season there are times when very large consignments of fruit come forward for storage, while at other times the quantities are smaller. It may often happen that the temperatures are well in hand, and if the attendant is aware that a large quantity of fruit is due the next day he is enabled by operating

on the battery to make preparation to receive the fruit and still maintain a uniform temperature during the loading of the chambers.

While the engineer is operating on the battery all the ducts can be checked, just allowing sufficient cold air to enter the chambers to remove the heat generated by the fruit and that leaking through the insulation, thereby maintaining a uniform temperature and making preparation for receiving the next day's supply. By the engineer observing the arrival of the various consignments at the works, and also the chambers in which the fruit is being stowed, and operating the shutters according to the number of cases being stowed in each compartment, the temperatures of the rooms can be maintained with only a slight variation during loading, owing to the fact that a portion of the refrigeration necessary to maintain the temperature has been stored in the battery.

DIRECT EXPANSION.

This system is by far the most simple method of cooling, and is usually installed in small stores which are operated by men without much mechanical knowledge. The coils, in which the ammonia expands, absorbs the heat, and produces the refrigerating effect, are placed on the walls of the cold rooms. As the ammonia expands in the coils the temperature of the pipes is reduced and the moisture from the air is deposited upon them in the form of snow. The snow has to be thawed off the pipes from time to time. For the purpose of taking the water away when the pipes are defrosted, gutters are fitted underneath the coils. The circulation of the cold air is set up by the air nearest the coils becoming the coldest, which continues as long as there is a difference in temperature between the air surrounding the coils and the average temperature of the room.

BRINE CIRCULATION.

In this system the ammonia is expanded in coils fitted in a tank which is utilized to cool the brine. The brine is then circulated through pipes placed in the various cool rooms.

The brine is drawn by a pump from the cooling-tank and is kept under a pressure which depends on the circumstances of the store, and may be anything from 10 lb. per square inch upwards. Under this pressure it is circulated through the coils, which are in series in the various rooms. The brine after passing through the coils is returned to the cooling-tank. As the brine is all the same temperature when it leaves the cooling-tank, it is obvious that in order to vary the temperature of any room it is only necessary to regulate the quantity of brine through the coils placed in it.

Nevertheless, great care has to be exercised in placing and installing a brine system, as in addition to the refrigerating system, the hydraulic side of the question has to receive attention.

DRY-BATTERY METHOD WITH AIR CIRCULATION.

When the battery system is discussed, the dry battery is often confused with the wet battery. In the latter the moisture is absorbed and its attendant impurities are destroyed by the cold brine, whereas in the dry battery, although the ammonia-expansion coils may be in a separate compartment, the moisture from the air accumulates on

the pipes and has to be thawed off from time to time in order to maintain refrigerating efficiency and a certain measure of control over the relative humidity of the air. Then, again, with the dry battery the air after passing through the fruit is not washed and purified, but is circulated continuously with all its attendant impurities.

Methods of distributing Refrigeration in Fruit-stores.

(1) The cold air is forced through a large trunk which is situated over the end of the storage-room. Openings are made in the bottom of this trunk and fitted with shutters for regulating the supply of cold air to the room, thereby controlling the temperatures. The suction or return trunk is situated in a similar position on the other end of the room, and through this the air, after passing over the fruit, returns to the battery. Where this system is installed it is necessary that a space 12 in. to 15 in. wide be allowed immediately underneath the delivery ducts, in order to facilitate a free delivery to the chamber, and also to minimize the danger of the fruit being frozen in this position.

(2) Similar trunking to that described under No. 1 is used, with the addition of auxiliary trunks leading from the main trunk to the centre of the chamber. These auxiliaries are fitted over the division walls, and branch T-wise, each one delivering air into the centre of two chambers. These trunks are also fitted with regulating shutters. By this method of trunking the difference in temperature between the main delivery and return air is minimized, as the length of the rooms is halved.

(3) Under this method there are also similar main trunks, with the addition of a false ceiling of slotted boards or perforations. With this system the cold air can be delivered in the chamber either through the ducts or through the false ceiling, or both together. The air, after passing over the fruit, is withdrawn through the ducts into the main trunk at one end of the chamber and returned to the battery. This system of distributing the refrigeration gives a uniform temperature throughout the storage-rooms.

(4) The cold air is delivered by trunks to a false ceiling. The air, after passing over the fruit, returns through a false floor to a main trunk, thence to the battery.

(5) This is a similar system to that of No. 4, but with a reverse air-flow—*i.e.*, from floor to ceiling—either through slotted or perforated boards. When this system of cold-air distribution is applied, it is necessary that ample dunnage be placed underneath the cases of fruit. If this precaution is not taken the cases when stowed will cover the apertures in the floor and stop the circulation.

(6) The air is forced through a large trunk over one end of the chamber. From this trunk the air is admitted through small perforated trunks which are carried round the top of the four walls inside the chamber. The air then, after passing through the fruit, returns by one large common duct in each room to the main return tunnel and battery.

These methods of distributing the refrigeration throughout the storage-rooms have proved most efficient where ample refrigeration has been available, and according to the attention paid to the necessary details.

PASTURE TOP-DRESSING IN CANTERBURY.

EXPERIMENTAL WORK BY THE FIELDS DIVISION, PERIOD 1924 TO 1930.

A. W. Hamer, Crop Experimentalist, Plant Research Station, Palmerston North, and L. T. Hunnisett, late Assistant Crop Experimentalist.

This report is divided into four parts as follows:—

I. Introduction.

II. Series of manurial and top-dressing experiments in which lime, phosphate, potash, and nitrogen were used.

A. Experiments north of the Rangitata River (Section 1 of map).

B. Experiments lying between the Rangitata and Rakaia Rivers (Section 2).

C. Experiments lying between the Rakaia and Rangitata Rivers (Section 3).

D. Experiments lying between the Rangitata and Waitaki Rivers (Section 4).

III. Experiments top-dressing experiments on Banks Peninsula (Section 5).

IV. Top-dressing experiments which were cut for hay.

Part I.—Introduction.

Importance of Grasslands in Canterbury.

Although Canterbury is the most extensive crop-growing province of New Zealand its grasslands are of paramount importance, as is indicated by the following figures drawn from the official statistics for 1928–29. Total area occupied, 2,500,000 acres; total area cultivated, 2,000,000 acres. The 5,000,000 acres not cultivated is "run" country mainly tussock grassland. Of the 2,000,000 acres cultivated 2,000,000 are in sown grasses, and the remaining 500,000 are used as follows: 350,000 acres for grain and pulse crops; 350,000 acres for green feed, roots, and grass for hay and for seed; 100,000 acres for market gardens, orchards, homesteads, &c.

It is thus obvious that grasslands occupy by far the greatest area, and that much of the arable land of Canterbury is used for crops to supplement the grass at times when grassland production is lowest. Nearly half the arable annually under the plough is used to provide winter feed for sheep or green feed for fattening lambs during the period January to March. Most of the grain growing is incidental to systematic renewal of pastures. In Canterbury, therefore as in other parts of New Zealand, increased national wealth is primarily concerned with greater grassland production.

Factors in Economic Grassland Production.

The chief factors affecting maximum economic grassland production are (1) species and strains of pasture plants, (2) utilization and management, (3) liming and manuring. It is not possible to arrange these factors in order of importance, because attention to one without consideration of the others will generally speaking lead to unsatisfactory results. Because of the importance of (1) and (2) in relation to manuring a few remarks concerning them will not be out of place here.

(1) SPECIES AND STRAINS.

The major grass species—rye-grass and cocksfoot—in relation to strain have been discussed by Levy and Davies in articles published in this *Journal*. Rye-grass is dealt with in the issues for July, 1929, and June and September, 1930, and cocksfoot in December, 1929.

A striking and valuable piece of information has resulted from the investigations of these workers. Out of 180 commercial lines of so-called perennial rye-grass collected from North, Middle, and South Canterbury, about 5 per cent. were found to be true perennial, and 14 per cent. were of a type which they describe as the "best false perennial," but which is decidedly inferior to true perennial. The remaining lines were "false perennial" or Italian rye-grass, which run out very rapidly even under high fertility.

Manuring a run-out pasture is never as satisfactory as manuring one containing a good proportion of the better and more persistent strains of such species as rye-grass, cocksfoot, dogstail, and white clover. The response to manure in the case of a run-out pasture is mainly from volunteer species which are principally annuals, the growth-period of which corresponds with the spring and early summer period of maximum production. These annuals fail to give much benefit in the low-production periods during the late summer to early spring. The increased production during early summer, without an appreciable benefit in the low-production periods, merely adds to the difficulties of utilization and management.

(2) UTILIZATION AND MANAGEMENT.

More attention to rotational grazing and the saving of surplus summer grass in the form of silage and hay could be made a profitable feature of grassland farming in Canterbury. Very little hay is saved except on dairy-farms, and ensilage is almost unknown in Canterbury, in spite of the fact that large quantities of grass are allowed to run away to rank summer growth, which is partly eaten and partly trampled by stock during the autumn and winter months. Where the formation of the country is such that silage-making or haymaking machinery can be used, this wasteful neglect is not justified. Further, the full benefits from manuring cannot be obtained unless the whole of the increased growth resulting is consumed when in a reasonably nutritious and digestible stage.

Trials conducted at the Canterbury Agricultural College, Lincoln, have demonstrated the possibilities for the province in increased carrying-capacity as a result of intensive utilization. (See article, "Pasture Management: Intensive Grazing for Canterbury Conditions," by M. J. Scott and D. J. Sidey, in this *Journal*, March, 1929.)

(3) LIMING AND MANURING.

Up to the present manuring with phosphatic fertilizers has been the most important single factor in the improvement of New Zealand pastures. It cannot be said that liming has been adopted seriously except in Southland, where the demand for lime has enabled it to be sold at the reasonable figure of 11s. to 12s. per ton. Canterbury has lagged behind other districts in the use of phosphate, top-dressing only 100,000 acres out of an approximate New Zealand total of 2,400,000 acres top-dressed each year.

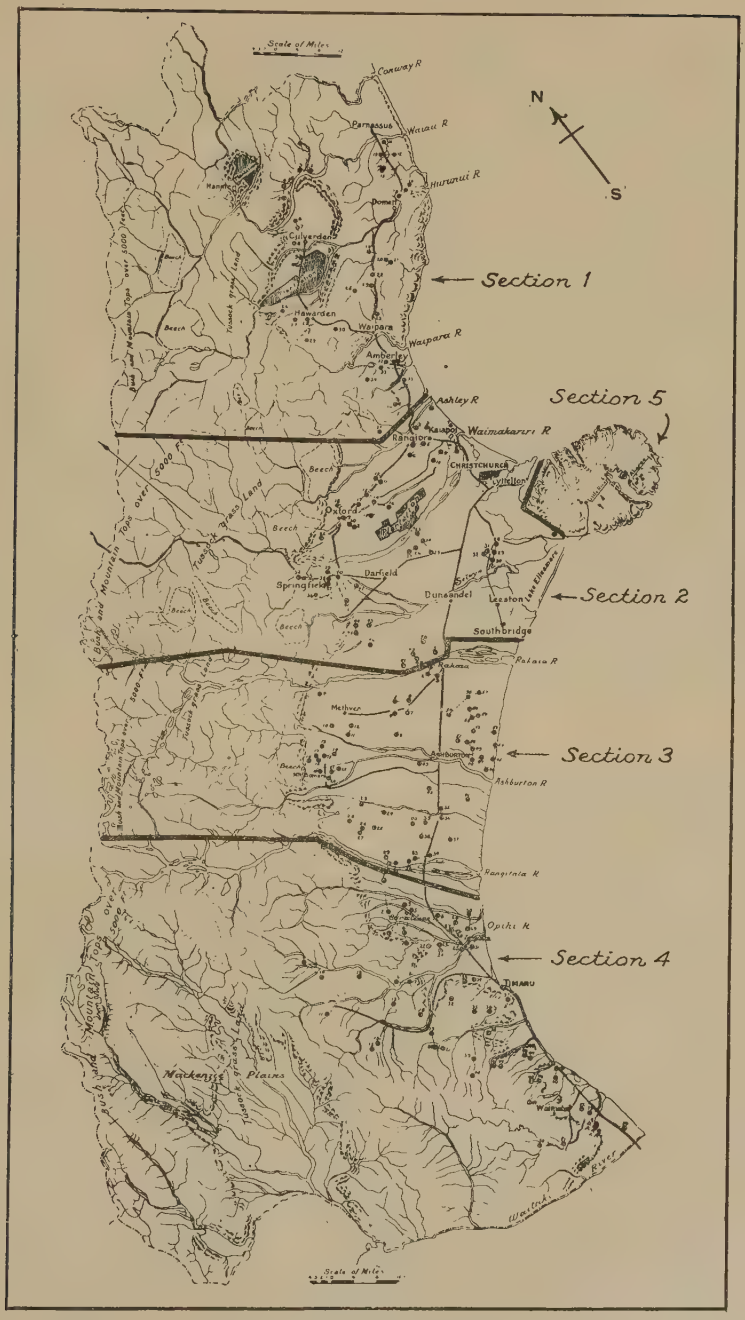

FIG. 1. MAP OF CANTERBURY, SHOWING DISTRIBUTION OF TOP-DRESSING EXPERIMENTS.

Section 1, north of Ashley River; Section 2, between the Ashley and the Rakaia; Section 3, between the Rakaia and the Rangitata; Section 4, between the Rangitata and the Waitaki; Section 5, Banks Peninsula. Each experiment is indicated by a numbered dot. (The thin black lines are railways.)

Scope of the Experiments.

In order to discover the most profitable channels for the extension of pasture-manuring in Canterbury, the Fields Division of the Department of Agriculture has been actively engaged of late years in carrying out experiments of two kinds:—

(1) Top-dressing experiments, in which the yields of material cut for hay have been measured:

(2) Observational top-dressing experiments, in which the effects of manure have been merely observed, as is indicated by the name given to these experiments.

The haying experiments were commenced in 1923, and details regarding them will be given in Part IV of this report. The amount of work entailed in the carrying out of these experiments seriously limited the number which could be conducted, and it was felt that information regarding manure response in Canterbury was not being obtained in a sufficiently large number of cases. Consequently a comprehensive scheme of observational top-dressing experiments was initiated in 1928. These will be discussed in Part II of this report, to follow.

The accompanying map, besides showing the distribution of the experiments, indicates generally the relationship of arable farming land (which includes most of the sown grasslands), tussock-grassland, and mountainous country. With the exception of Banks Peninsula, nearly all the experiments were laid down on ploughable land. Each section of the map will be shown on a larger scale in Parts II and III.

(To be continued.)

NAURU AND OCEAN ISLAND PHOSPHATE SUPPLIES.

Shipments of phosphate from Nauru and Ocean Islands for the year ended 30th June, 1930—the tenth year of operations under the British Phosphate Commission—totalled 504,173 tons, compared with 501,915 tons in 1927–28 and 576,590 tons in 1928–29. The cause of the decreased shipments last year was the severity of the weather experienced during the westerly monsoon season, which was considerably worse than usual, with the result that three out of the four sets of deep-sea moorings at the two islands were carried away, and re-laying them was a difficult operation.

The quantity of Nauru/Ocean phosphate imported into New Zealand in 1929–30 was 117,826 tons. The Commission also supplemented this by outside supplies, amounting to 49,983 tons, imported from Makatea Island and Morocco.

Importations for the three past years are as follows:—

	1927–28. Tons.	1928–29. Tons.	1929–30. Tons.
Nauru/Ocean	136,718	138,053	117,826
Morocco and Makatea ..	42,946	29,288	49,983
	179,664	167,341	167,809

The shipped output of phosphate from Nauru and Ocean Islands for 1929–30 was all absorbed by Australia and New Zealand as follows: Total, 504,173 tons; Australia, 377,073 tons (74·79 per cent.); New Zealand, 127,000 tons (25·21 per cent.). For the two preceding years the Dominion took 24·76 and 24·66 per cent. of the total respectively.

THE DIAMOND-BACK MOTH.

ITS OCCURRENCE AND CONTROL IN NEW ZEALAND.

J. MUGGERIDGE, B.Sc., Entomology Section, Plant Research Station, Palmerston North.

As far back as 1837 Curtis (1883) in his "Farm Insects" referred to the turnip diamond-back moth under the name of *Cerostoma xylostella*. Curtis stated that it was earlier referred to by Linnaeus as *Tinea xylostella* from its feeding upon honeysuckle, which bears that name. It was also known for years as *Plutella cruciferarum* Zell., but Whitehead (1894) pointed out that Curtis had previously described it in 1831 under the species name *maculipennis*. This latter terminology was subsequently confirmed by Meyrick, and the name *Plutella maculipennis* has been adopted generally for the moth. The moth was probably introduced into New Zealand from England or Australia fifty or sixty years ago, or even earlier. Kirk (1894) mentioned that this insect first came under his notice in the Wellington District in the year 1879. Meyrick (1885) recorded the presence of the moth in the Waikato, Wellington, Taranaki, Christchurch, Bealey River, and Lake Wakatipu districts. From this it will be seen that distribution was fairly general at this early date. To-day the moth is distributed throughout New Zealand, and is a serious pest of cruciferous crops in both the North and South Islands, but more especially in the latter.

The diamond-back moth is cosmopolitan in range, occurring throughout the world from Greenland to New Zealand. In common terms it is also named "cabbage moth," "cabbage web moth," "cabbage-leaf miner," and "green cabbage worm."

ECONOMIC IMPORTANCE IN NEW ZEALAND.

The total area of cruciferous crops (mostly brassicas) grown in New Zealand is upwards of 600,000 acres, of which turnips (including swedes) form the largest part, with some 475,000 acres. The greater portion of this latter area is situated in Canterbury, Otago, and Southland, the figures for the different districts in 1929–30 being Canterbury, 151,228 acres; Otago, 99,551 acres; Southland, 112,754 acres; remainder of Dominion, 111,721 acres. Rape is an important green crop, and chou moellier is extending in use.

While the depredations of the moth are general throughout New Zealand, the most serious losses are experienced in parts of Canterbury and Northern Otago. The attacks, however, vary considerably according to the locality. Inland towards the hills, for instance, the crops appear to be more vigorous, and moth attacks are not so noticeable. On the flat country towards the coast, on the other hand, and especially where the land is inclined to be light, the moth-attack may be very severe, in many cases almost completely destroying foliage, with consequent loss of the crop.

Acreage figures alone do not convey an adequate impression of the importance of these crops to New Zealand agriculture. For the fattening of lambs and for the wintering of stock they are indispensable, no

less so in every market and home vegetable garden, so that the insects and diseases which attack them are of primary importance. Aphis, as well as diamond-back moth, causes severe damage especially in the drier parts, and it is difficult to assess separately the loss caused by each.

It is probable that over all the cruciferous crops grown in New Zealand diamond-back moth causes the most severe losses and most urgently calls for the devising of methods for its control.

Importance in other Countries.

Throughout the literature on the subject there are varying accounts regarding the economic importance of diamond-back moth in other parts of the world. In some countries, such as Australia, South Africa, and Argentine, its depredations are the cause of serious economic loss to cruciferous crops. In England at times it ranks as a serious pest, but only occasionally are large economic losses involved. Records show that serious outbreaks of diamond-back moth took place in the years 1837, 1851, 1888, 1891, 1901, and 1914. These outbreaks in some instances were particularly severe, and whole fields of turnips, swedes, rape, and cabbage were destroyed, cabbages generally being the most severely attacked. What holds the moths in check during the intervening years one cannot definitely say; but in all probability the main check is due to insect parasitism, the most important parasites recorded being *Angitia plutella* Viereck., *A. fenestralis* Holmgr., and *A. (Limneria) gracilis* Grav.

The reason for the periodic outbreaks has been attributed by Miss Ormerod (1901) to periodic invasions of the moth from the Continent along the east coast of England. From the literature, however, it does not appear that this insect is a pest on the Continent. Such being the case, the migration theory is hardly tenable. It is very probable, then, that the outbreaks are not due to any one circumstance, but rather that the increase is governed by an ecological complex which in the main favours an abnormal increase of the moth.

In Germany, France, and Italy this insect, as already indicated, is not present in sufficient numbers to be a serious pest, and in the last-named country it is comparatively rare. In parts of European Russia, in Siberia, and in Finland it occasionally causes considerable loss. In Canada and the United States it is sometimes serious, though Marsh (1917) quoted it as a striking example of a potentially serious pest normally held in repression by parasites, the most important being *Angitia plutella*. The incidence of the attacks of the moth in other parts of the world is very important from the point of view of its biological control in New Zealand. It is a first principle of control by this means that a parasite which fails to exercise a control in its country of origin is not likely to do so elsewhere, apart for the present from such considerations as superparasitism or hyperparasitism.

Description of the Insect.

The moth (Fig. 1) is a small slender greyish insect having a wing expanse of about 7 mm. (about $\frac{3}{8}$ in.). When at rest the wings are folded closely to the sides, the terminal edges almost touching and

having a slightly turned up appearance. The narrow creamy-yellow band bordering the dorsum and extending from the base to near the tornus is edged with black on the disk in a wavy irregular fashion. It is from the discal contour of this band that the common name "diamond-back" came to be applied. For detailed description reference may be made to Hudson (1928).

The eggs (Fig. 2) are oval and cylindrical in shape, but on the leaf they appear to have a more flattened appearance. They are light lemon-yellow in colour, have a crinkly surface, and measure less than 1 mm. in length. Before hatching the egg becomes paler in colour, and gradually the outline of the larva becomes distinguishable. It is bent nearly double, so that the dark head end just reaches the anal extremity.

The larva (Fig. 3) on hatching is a minute grub about 2 mm. in length. It is pale in colour with a dark head. The adult larvæ are variable in colour, but the majority are mainly green, a coloration which no doubt affords them a certain amount of protection from their enemies. Each measures 7 to 9 mm. in length, being widest at a distance slightly posterior to its middle, from which point it tapers posteriorly and anteriorly.

The pupa (Fig. 4) measures 7 mm. in length. When first formed it is light-green in colour, but it gradually changes to white with brownish markings. It is enclosed in a neat open net-work cocoon (fig. 9) opening at both ends, and firmly glued to the place where pupation takes place.

Life-history and Habits.

The moths are nocturnal in habit, but are readily disturbed from their hiding-places during the day. Their flight is weak and uncertain, and they soon come to rest again among the host plants. The normal life of the moth in summer months is between six and seven days. Shortly after emergence of the adults mating takes place, an act taking upwards of two hours. The number of eggs laid by a single moth varies between ninety-two and 130. The eggs are deposited in either side of the leaves of the host plant, but mostly they are to be found on the under-surface. They may be laid singly or in batches of from two to eleven. Usually oviposition takes place along the ribs or veins of the leaves, or it commonly happens that a yellowish patch on the leaf is selected.

The eggs hatch in five to six days after oviposition, and almost immediately after hatching the larvæ commence feeding by boring through the cuticle of the leaf and mining in the tissue beneath. These mines are quite conspicuous in the early stages, since they show up as numerous white markings in the leaves. From four to five days after hatching the young larva emerges from its mine to undergo its first moult. Always when about to moult the larva selects the most sheltered place available, such as a furrow on the leaf or near an edge which is slightly turned over. A few protective silken threads are then spun and moulting takes place beneath. Mining may be continued for a short time after the first moult, and then feeding commences on the under external leaf-surface. Two further moults take place before the adult larval stage is reached, the second skin being shed five days after the first, and the third skin four days later.

FIG. 1. DIAMOND-BACK MOTH ADULT. ENLARGED.
[*After Marsh.*

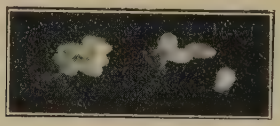

FIG. 2. EGGS OF DIAMOND-BACK MOTH. ENLARGED.
[*Photo by H. Drake.*

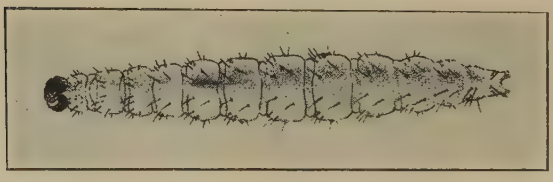

FIG. 3. LARVA OF DIAMOND-BACK MOTH. ENLARGED.
[*After Marsh.*

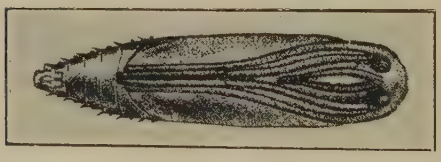

FIG. 4. PUPA OF DIAMOND-BACK MOTH. ENLARGED.
[*After Marsh.*

Both young and old larvæ are very sensitive to touch, and both are readily disturbed. On the approach of danger they drop from their feeding-places and remain suspended by a silken thread, by means of which they return to the leaf after all danger is apparently past. On the slightest touch they will curl into a loop or wriggle backwards in a frantic endeavour to escape. Most injury is done to the plants between the time following the first moult and up to the time that

the larva constructs its cocoon. During this period the leaves are eaten out in irregular patches (Fig. 5), and very often they are completely skeletonized.

On the third day after the adult larval stage is reached the larva spins its network cocoon, in which the last larval skin is shed and the pupa is formed. Pupation usually takes place on the under-surface of

FIG. 5. CABBAGE-LEAF SHOWING TYPICAL DIAMOND-BACK MOTH INJURY.
[*Photo by H. Drake.*

the leaf, though larvæ about to pupate will readily migrate from the host to seek some nook or cranny which might afford protection. They will pupate on plants entirely different from the host, such as Scotch thistle (*Circium lanceolatum*) or sow-thistle (*Sonchus oleraceus*). Twelve days after pupation the adult moth emerges, and so the cycle commences anew.

While the life-history as above given is true for certain periods of the year, such as the February–March period, a glance at Table 1 under the heading of "Seasonal History" will show the great variation which occurs at other times of the year.

Seasonal History.

So far as the writer's observations go, there appears to be no true hibernating period of the moth in New Zealand. It is quite possible, however, that in the colder parts of the South Island hibernation may take place in the pupal stage, as it does in some other parts of the world. All stages of the moth vary in length according to temperatures and humidities. Temperature has the greatest influence, however, since it is always with the advent of the colder weather that the different stages occupy a longer period. The following table records the individual life-cycles of the moth through the different seasons of the year as observed at this Station:—

Table 1.—Life-cycle of Diamond-back Moth at different Seasons of the Year.

Eggs laid (dates) ..	16/2/29	20/3/29	27/7/29	27/10/29	12/12/29	5/2/30	14/3/30	22/4/30
Eggs hatched	21/2/29	26/3/29	18/8/29	5/11/29	19/12/29	10/2/30	20/3/30	4/5/30
Larvæ pupated ..	7/3/29	12/4/29	9/10/29	26/11/29	6/1/30	25/2/30	6/4/30	18/6/30
Adults emerge	19/3/29	24/4/29	22/10/29	7/12/29	16/1/30	7/3/30	19/4/30	14/7/30
Length of egg stage (days)	5	6	22	9	7	5	6	13
Length of larval stage ..	15	17	52	21	18	15	17	45
Length of pupal stage ..	12	12	13	11	10	10	13	26
Total length of cycle ..	32	35	87	41	35	30	36	84

During the period from 27th July, 1929, to 14th July, 1930—a year all but thirteen days—six generations of the moth were reared, but from an examination of the table it will be realized that seven generations are possible within this period.

Hosts.

In New Zealand the common hosts are cabbage, cauliflower, turnip, swede, kale, and chou moellier. Cabbage is the preferred host, and during February and March the attacks on this plant are so severe as to render their growing very difficult.

In addition to the foregoing hosts Marsh (1917) recorded the following: Chinese mustard, watercress, horse-radish, sweet alyssum, candytuft, and hedge mustard. Reichardt (1919), *inter alia*, also mentions wall-rocket, wallflower, wild radish, shepherd's purse, Russian thistle, and chick-pea.

Direct Methods of Control.

Many sprays and dusts will control the moth, generally by coating the leaves with some poison which when ingested kills the larvæ. The usefulness of these materials is, however, limited by the fact that in its early life the larva feeds in self-made tunnels within the tissue of the leaf and so avoids any poison on the surface. This habit makes it necessary to spray or dust at fairly frequent intervals in order to catch successive broods as they emerge. Spraying is slow and tedious, since it is even more important to coat the underside of the leaves with poison than the upperside.

The expense and mechanical difficulty of spraying or dusting field crops by any method so far evolved is quite prohibitive. Gardeners who desire to preserve cherished plants from the ravages of the moth may do so by using Marsh's formula—Paris green, 1 lb.; common laundry soap, 3 lb.; water, 50 gallons. The effectiveness of this spray is dependent on thoroughness of application.

Biological Control in New Zealand.

Work on biological control was undertaken at the Plant Research Station primarily to ascertain what parasites and predators are present in New Zealand, and, if possible, to improve the degree of control biologically by the importation of further beneficial insects. The investigation, therefore, has necessitated the collection and rearing of the moth or its parasites from pupæ and adult larvæ (chiefly the latter) collected from different parts of New Zealand. From 1,768 specimens collected 1,582 moths and 120 parasites were reared, while the remainder gave no emergence and on examination proved not to be parasitized. The degree of parasitic control, therefore, is approximately 7 per cent. This percentage is far too small to be of any economic value, and is, moreover, far below that recorded in countries where other parasites occur. In England, for instance (Harper Gray, 1915), up to 89 per cent. of parasitic control has been recorded.

Up to the present only one species of parasite has been found to attack the diamond-back moth in New Zealand, and this species has been identified by the Imperial Institute of Entomology as *Angitia lateralis* Grav. (Fig. 6). The Institute states that while there is no question that it belongs to the genus *Angitia* some doubt exists as to the species, since all the authorities agree that it is extremely near to *lateralis* but certainly differing slightly.

Parasitism takes place in the larval stages, but it does not prevent the moth larva from completing its development and pupating as usual. The parasite then completes the destruction of its host, and emerges to spin its own tough and closely-woven silken cocoon (Fig. 7) within the cocoon of its host. Prior to emergence, which takes a week or more longer than would ordinarily be taken by the host, the parasite cuts a neat hole through one end of its cocoon. Just as there are numerous generations of the moth, so apparently there are corresponding generations of the parasite. One possible hyperparasite has been found, but is not yet identified.

In addition to the *Angitia* parasite attacking *Plutella maculipennis* larvæ Miller (1918) has recorded two Syrphid predators—*Syrphus novæ-zealandiae* Macq. and *Malanostoma fasciatum* Macq.—both common hover-flies well distributed in New Zealand. The *M. fasciatum* larva is light-green in colour and has a slimy slug-like appearance. The writer has frequently observed its attacks on diamond-back larvæ. It applies its mouth parts to the victim, and in twenty to thirty minutes sucks out the whole of the internal juices, leaving nothing but an empty skin. How many may be destroyed in this fashion by any one syrphid has not been estimated. Unfortunately, the good they might do is greatly curtailed owing to the presence of the parasite *Bassus laetatorius* Fabr. From the few observations made this insect gave a high percentage of parasitism. It has also been recorded as a parasite of *S. novae-zealandiae*.

Besides entomophagous insects the larvae are heavily attacked by an entomogenous fungus. In some places 60 or 70 per cent. control is afforded by this means, but, unfortunately, it comes too late in the season to be of value. The fungus is widely distributed in New Zealand, being common in both the North and South Islands. Larvæ when attacked become sluggish and turn slightly yellow before dying, shortly after which they become quite unrecognizable and finally only a flattened outline remains. This is probably the fungus referred to by Hilgendorf (1902) under the name *Entomopthora radicans* and mentioned by Cunningham (1927) as a Phycomycete. Hilgendorf was able to infect healthy *Plutella* larvæ, but not with any degree of certainty.

FIG. 6. ANGITIA LATERALIS, A PARASITE OF DIAMOND-BACK MOTH ALREADY PRESENT IN NEW ZEALAND. ENLARGED.

[*Original.*

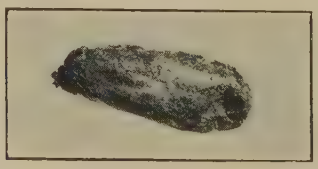

FIG. 7. COCOON OF ANGITIA LATERALIS. ENLARGED.

[*Photo by H. Drake.*

Parasites and Predators in other Countries.

The diamond-back moth has many enemies, both parasites and predators, but more especially the former. The following have been recorded from various parts of the world. A few brief notes taken from various publications are given in regard to each insect. With the object of reducing the present serious ravages of the moth larva it is proposed to introduce into New Zealand the two species first mentioned (*Angitia plutella* and *A. fenestralis*).

Angitia plutella Viereck (Fig. 8).—This insect is found in England, Europe, and the United States of America. Marsh (1917) stated it was not unusual to get from 50 to 70 per cent. of the later generations of *Plutella* larvæ infested by this parasite. Parasitism takes place in the larval stage. The host larvæ mature and spin their cocoons. "The larvæ of *A. plutellae*, one from each *Plutella* larva, issue and spin compact grey cocoons within the *Plutella* cocoons." A Chalcid hyperparasite, *Spilochalcis delira* Cresson, is recorded, but it was never sufficiently numerous to affect its host seriously.

Angitia fenestralis Holmgr.—This insect appears to be generally distributed in England and Europe and is regarded as a very efficient parasite of *Plutella maculipennis*.

Reichardt (1919) stated that this Ichneumonid parasitized all instars of the larva of the host, the degree of infestation reaching as high as 70 per cent. From this same source it is pointed out that the larva abandoned its host two to seven days after the latter had spun its cocoon in which the parasite made its own. The adult emerged in twelve to twenty-three days, according to temperature conditions.

Miles (1924) mentioned that an attack of *P. maculipennis* in Lincolnshire in 1923 was practically destroyed in the second generation by *A. fenestralis*. A hyperparasite, *Mesochorus* sp., is recorded.

According to Meier (1925) *A. fenestralis* is a parasite of various microlepidoptera, and all species of *Hyponomeuta*. It attacked the host larva in all stages and was able to breed throughout the year, though it did not completely control its host. It did not oviposit in all larvæ and some of the eggs deposited did not develop since in some cases they became surrounded by the tissues of the host and perished.

Angitia cerophaga Grav.—Voukassovitch (1927) reported that this insect was a prevalent parasite of *P. maculipennis* in the vicinity of Belgrade. *Plutella* larvæ were attacked by both fertilized and unfertilized females in the laboratory. They frequently oviposited in the young larvæ within their mines, of which they attacked several in turn. The older larvæ were not nearly so readily attacked. Parasitized larvæ completed their development and constructed their cocoons. A day or two later the parasite larvæ emerged and spun their cocoons within that of the host. The pupal stage lasted for seven or eight days at about 75° F. The male life-cycle occupied eighteen days at 71° F. An unfertilized female produced only five males.

Angitia polynesialis Cam.—Timberlake (1917) recorded this insect as being common in Hawaii and in the United States. He stated it is not unlikely that this species occurs in Europe and that an earlier name may be found for it.

Angitia (Campoplex Limneria) majalis Grav.—This insect is widely distributed in Europe and parasitizes the pupæ, only one larva being found in each host. No accounts are available regarding its effectiveness as a parasite.

Angitia (Campoplex Limneria) gracillis Grav.—Reichardt (1919) stated that *A. gracilis* infested 89 per cent. of *P. maculipennis* cocoons during the 1914 season in England. This is probably an error in the translation of Harper Gray's (1915) account. This latter author mentioned that of two hundred cocoons taken from a turnip-field

during an outbreak of the moth in 1914 only twenty-two moths emerged, while the remaining 178 were parasitized, *Limneria gracilis* Grav. being one of the parasites concerned. The degree of parasitism in this instance was 89 per cent., but it is unfortunate that the separate percentages for the different species concerned were not given.

FIG. 8. ANGITIA PLUTELLA, ONE OF THE PARASITES IT IS PROPOSED TO INTRODUCE. ENLARGED.

[*After Marsh.*

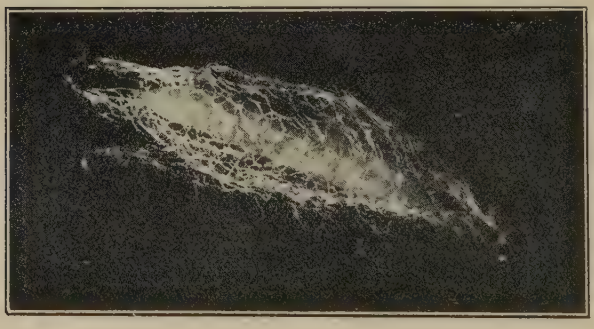

FIG. 9. COCOON OF DIAMOND-BACK MOTH WITH PUPA INSIDE.

[*Photo by H. Drake.*

Pimpla alternans Grav. — Voukassovitch (1927) stated that this insect was found in almost equal numbers in larvæ and pupæ; in the former case its cocoon was found close to the remains of the larva within the cocoon that *P. maculipennis* had constructed. The degree of parasitic control was slightly over 30 per cent.

Sagaritis latrator Grav. — In 1912 about 40 per cent. of the caterpillars in Astrakhan, Russia, were infested with this parasite.

Various other parasites have been reared from *Plutella* larvæ, but no reliable accounts are available regarding their effectiveness as controls. These are *Microplitis plutellae* (an Ichneumon) in North America; *Limnerium leontiniae* (an Ichneumon) in Argentine; *Tumidicoxella plutellophaga* (a Chalcid) in Australia; *Diadromus subtilicornis* Grav., and *Thyraeella collaris* Grav., near Belgrade, the former being a parasite of the pupa; *Tamelucha plutellae* Ashm. has been obtained from the pupæ of *P. maculipennis* in Saratov and Astrakhan, each pupa harbouring fifteen larvæ of the parasites; *Phygadeuon rusticellae* Bridgm. in England; *Apenteles plutella* Kurd. in Poltava. *Tetrastichus sokolowskii* Kurd. also occurs in Poltava, but is sometimes a hyperparasite, attacking the larvæ of *Angitia plutella*. Finally, from the United States Marsh (1917) recorded a new species of *Microplitis*, *Meteorus* sp., and *Mesochorus* sp. Regarding this last parasite it has been noted that Miles (1924) recorded a *Mesochorus* sp. in England as a hyperparasite.

Predators.—Apart from parasites above mentioned, a few predators of *P. maculipennis* have been recorded. These consist of two Coccinellid beetle larvæ (*Coccinella septempunctata* L. and *Coccinella (Propylaea), quatuordecimpunctata* L., occurring in Russia, and a large green Mantid, *Sphodromantis gastrica*, in South Africa. With regard to this last insect Gunn (1917) stated that it was frequently found in large numbers both in the nymphal and adult stages in infested fields and large numbers of *P. maculipennis* larvæ were destroyed by it. Unfortunately, however, it did not appear until too late in the season to be of any value.

Other enemies of diamond-back moth recorded are birds and fungi. Regarding the latter, it is remarked in a publication by Lind, Rostrup, and Kolpin Ravn (1914) that *Entomophthora radicans* killed the remaining *Plutella* larvæ in the latter part of the season of 1914, following a severe outbreak of the pest in Denmark.

Summary.

The diamond-back moth, which is a cosmopolitan species, is a serious pest of cruciferous crops in New Zealand. There are six generations of the moth a year, and all stages are to be found throughout the different seasons. The natural enemies of the moth in New Zealand include insects and fungi, but none of these is found capable of exercising the control desired. In other parts of the world the ravages of this insect are greatly reduced owing to the presence of certain beneficial parasites. It is therefore proposed to introduce two of these parasites, *Angitia fenestralis* and *Angitia plutella*, into New Zealand in the hope that they may reduce the moth depredations in this country to uneconomic proportions. The Imperial Institute of Entomology is undertaking the despatch of these insects, and it is expected that consignments will arrive here in time for this work to be undertaken during the present season.

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NOTE.—The figures in parentheses above refer to the volume and page respectively in the "Review of Applied Entomology," Series A, where extracts of the articles referred to may be seen.

The writer's thanks are due to members of the Fields Division for their willing help and co-operation in the prosecution of this work; to the Imperial Institute of Entomology for the identification of the parasites reared; and to Dr. G. H. Cunningham and Mr. J. C. Neill, of the Plant Research Station, for helpful suggestions in the preparation of this article.

INTENSIVE GRASS-FARMING.

DAIRY-FARM EXPERIMENTS AT MANAWARU, SEASON 1929–30.

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The experiments in rotational grazing and intensive manuring commenced on Mr. John Ward's farm at Manawaru, Piako County, in 1927, and described in this *Journal* for December, 1928, and October, 1929, was continued during the 1929–30 season. Although the early experimental work was hampered to some extent by various setbacks in the form of a severe drought in 1927 and floods in 1928, information was obtained on the technique of rotational grazing and the usefulness of intensive manuring and improved methods of grass utilization for increasing butterfat production. Production was increased from 161 lb. of butterfat per acre in the 1926–27 season to 212½ lb. per acre in the 1928–29 season.

The information gained on rotational grazing from the last two seasons' experience may be briefly stated as follows:—

(1) The storing-up of a reserve of hay and ensilage should always precede the adoption of more intensive methods of grass-farming and an increase in the number of the dairy herd.

(2) The size of the fields on rotationally grazed farms is determined by the rate of stocking, and it would appear that this should be at the rate of twelve to eighteen cows per acre, more or less, according to the fertility of the land.

(3) A good even grass-growth 3 in. to 4 in. high will give two grazing-days of twenty-four hours each for twelve to eighteen cows per acre.

(4) When the grass-recovery period is prolonged through adverse weather conditions the feed produced by the pastures should be supplemented with grass ensilage, concentrates, or a combination of the two.

During the 1929–30 season the foregoing conditions were put into effect or further investigated. The farm was further subdivided so that it consisted of sixteen fields of approximately 3 acres each. All fields were supplied with water, and each field opened on to the central race. The lay-out is shown in Fig. 1.

Manuring and Management of the Pastures.

Three dressings of superphosphate, each at the rate of 2 cwt. per acre, were applied to all pastures during July and December, 1929, and April, 1930. Eight of the fields were top-dressed with 2 cwt. of sulphate of ammonia during July, and again with 1 cwt. in April. No further dressings of lime were applied during the 1929–30 season, but the ½-chain strips across each field treated with potash in 1929 were again top-dressed with 2 cwt. per acre of 30 per cent. potash salts in June, 1930. Frequent observations made during the season failed to locate any difference, either in pasture composition, colour, or grazing, on the limed areas or on the potash strips, from the areas not treated.

Fields were grazed as far as possible when the grass-growth was about 3 in. to 4 in. high, and the herd of thirty-six cows was generally able to consume this in two days. Dry stock followed the main herd to clean up thoroughly any residual grass, and the mower was used to trim off seed-heads where necessary. During the winter, spring, and early summer the fields were harrowed after each grazing. No set rotation was followed for grazing the fields, but the milking herd after feeding off one field was moved to the one next ready for grazing. Any tendency for the feed to get ahead of the herd was checked by closing the more advanced fields for hay and ensilage. Four fields were closed for ensilage in September, and three for hay in October. As the weather turned out to be so favourable for grass-growth right up to mid-February another field could safely have been closed, but in October it was not considered safe to do this, and the control of the pastures did not suffer to any extent by neglecting to do so.

The ensilage was made during November in two stacks each calculated to hold about 36 tons of material, and harvested before the flowering of the grass took place. A large stack of hay was harvested from three fields during December.

Value of Nitrogen as a Top-dressing.

An investigation into the usefulness of nitrogenous fertilizers for grassland has been carried out on Mr. Ward's farm for the past three seasons, but up to the present little has been published on this phase of the experimental work.

During the 1927–28 season (see *Journal*, December, 1928) sulphate of ammonia was applied in early November and again in March, but on account of the summer drought only the March application proved of benefit. During the following season, 1928–29, when four dressings each of 1 cwt. per acre were applied to six of the fields, the effects of the July dressings were almost nullified by the floods which followed soon after application. Dressings applied in October and December did not give any appreciable response, but the March dressings stimulated growth during the late autumn and provided useful feed in the early winter.

The trials on this farm and others conducted elsewhere in Auckland Province indicate that only the July–August and March–April dressings are likely to be payable, and that the best results are obtained if rain falls immediately after the application of the nitrogenous fertilizer. Dressings during May or June may give good results provided rain is plentiful and severe frosts do not occur soon after application. Applications prior to dry weather generally give little immediate response, and may even do temporary harm to the pasture by "burning" with subsequent suppression of clovers.

In the 1929-30 season eight fields, comprising half the farm, were treated with 2 cwt. of sulphate of ammonia. The dressings commenced on 9th July and were completed on 24th August. The nitrogen-treated fields were selected so that each could be compared with a control field alongside which had been originally part of the same pasture. Only two of the nitrogen fields had previously received any different treatment from the corresponding control fields. These two nitrogen fields had received four dressings of sulphate of ammonia during the previous season, while the controls had none.

In order to view the results of the late winter dressings in proper perspective it is necessary to divide the time between the first grazings and the autumn applications into four periods. The first period extended from 15th August to 12th October, when all fields were being grazed and during which any extra feed was most desirable. The second period, between 12th October and 21st December, was one when

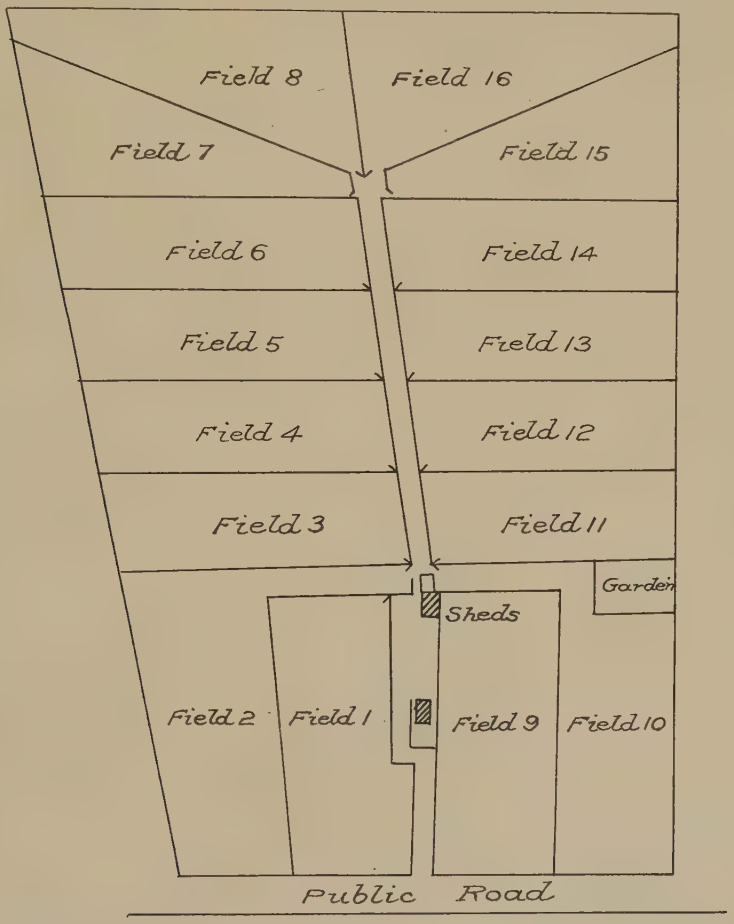

FIG. 1. LAY-OUT OF MR. WARD'S FARM IN 1929–30 SEASON.
Fields approximately 3 acres each. Total area, 50 acres.

there was a superabundance of feed on the farm, and during which seven fields (21 acres) were closed for hay and ensilage. It is safe to say that in this period extra feed was least necessary, especially during such a season as the one under review. The third period, between 22nd December and 17th February, was one when there was ample feed, as the aftermaths of the hay and ensilage fields were available for grazing. The fourth period, between 18th February and 11th April, was a time of scarcity, as dry weather prevailed.

Table 1 shows the results of grazing the fields on the farm during each of the four periods described, expressed as cow-days per acre. Cow-days per acre are obtained by multiplying the number of cows grazing the particular field by the number of days grazed and dividing the resultant figure by the area. Dry stock following the main herd have also been taken into consideration, each animal being calculated as a fraction of a cow according to its age and type. Averaging the four periods the fields treated with nitrogen plus phosphate gave 187 cow-days per acre, and the control fields treated with phosphate gave 192 per acre, a difference of 5 cow-days in favour of the control. During the first period, however, there was a difference of 6·9 cow-days in favour of the nitrogen fields, and during the second period there was also a difference of 5·3 cow-days in their favour. During the third and fourth periods there were differences in favour of the controls of 7·3 cow-days and 9·9 cow-days per acre respectively.

Individual fields, however, have given widely different results, due no doubt to the diversity of composition and age of the pasture. Field 9, treated with nitrogen, gave substantial increases over the control Field 10 during all four periods, whereas Fields 13 and 16 failed to respond. These two fields are the ones already mentioned as having had slightly different previous treatment from their controls in that they received four applications of sulphate of ammonia during the 1928–29 season. These dressings had caused a marked depression of white clover in these fields, which, however, was not lasting in Field 13. This field, in common with Field 14, suffers from a lack of good rye-grass. Evidently these fields were sown down in 1927 with a poor type of rye-grass, which has failed to persist, and it is no doubt due to this fact that the poorest results were obtained from the nitrogen application to Field 13. Although nitrogen stimulates rye-grass to a marked extent, it cannot create what is not present in the first place, and experience goes to show that nitrogenous fertilizers should be applied only to those fields having a good proportion of rye-grass in their composition. This is borne out by the fact that those fields having the greatest amount of rye-grass gave the best results during the first period. The value of nitrogenous fertilizers for providing early spring feed is apparently greatest on dominant rye-grass pastures, and on many dairy-farms the adoption of nitrogen top-dressing will not be profitable until the pastures are improved by re-establishment with truly perennial strains of rye-grass.

The nitrogenous dressings applied in July on this farm have not produced any extra growth for the season as a whole, but they have promoted extra growth in the spring at the expense of summer growth. It was the stimulation of rye-grass which was largely responsible for the extra spring feed, and it happens that the subsequent depression coincided with the seasonal decline of rye-grass.

Nitrogenous fertilizers are therefore useful for stimulating an early spring growth of rye-grass, and any decline in production from nitrogen-treated fields later in the season may be more than compensated for by the extra value of grass-growth in the early spring. The provision of a good supply of grass for early-calving cows has a marked effect on production over the whole season, and the value of the feed

produced in the early spring with nitrogenous fertilizers cannot be expressed merely in terms of the extra butterfat produced in the early spring.

Table 1.—Grazing-days from Nitrogen and Control Fields.

Field No.	Treatment.	Cow-days per acre at various Periods.				
		15/8/29 to 12/10/29.	13/10/29 to 21/12/29.	22/12/29 to 17/2/30.	18/2/30 to 11/4/30.	Total.
1	Sulphate of ammonia	55	106	46	27	234
2	Control	38	112	50	36	236
	Difference* ..	+17	−6	−4	−9	−2
3	Sulphate of ammonia	59	†	†	†	59
4	Control	60	†	†	†	60
	Difference ..	−1	..	..	..	−1
5	Sulphate of ammonia	38	‡	30	46	114
6	Control	26	‡	29	85	140
	Difference ..	+12	..	+1	−39	−26
7	Control	12	‡	54	50	116
8	Sulphate of ammonia	22	‡	48	58	128
	Difference ..	+10	..	−6	+8	+12
9	Sulphate of ammonia	69	152	52	41	314
10	Control	45	120	44	40	249
	Difference.. ..	+24	+32	+8	+1	+65
11	Sulphate of ammonia	67	124	64	52	307
12	Control	64	115	66	52	297
	Difference.. ..	+3	+9	−2	..	+10
13	Sulphate of ammonia	71	91	63	32	257
14	Control	75	105	75	62	317
	Difference.. ..	−4	−14	−12	−30	−60
15	Control	25	‡	57	42	124
16	Sulphate of ammonia	23	‡	26	40	89
	Difference.. ..	−2	..	−31	−2	−35
Mean difference in favour of nitrogen		6·9	5·3	..	..	..
Mean difference in favour of controls		..	..	7·3	9·9	5·0

* Differences in favour of sulphate of ammonia indicated by + sign; those in favour of control indicated by − sign.

† Control field cut for hay; nitrogen field grazed. Treatments not comparable after cutting.

‡ Closed for hay or ensilage.

NOTE.—Control fields received phosphates only. Nitrogen fields received the same quantity of phosphate as the controls and 2 cwt. of sulphate of ammonia in July-August in addition.

Management of the Dairy Herd.

The milking herd on Mr. Ward's farm during the 1929–30 season consisted of thirty-six Friesian cows, most of which were pedigree animals. There were also five heifers, five calves, two bulls, and two working-horses on the farm.

Unfortunately, a number of the cows calved late, and this had a detrimental effect on production during the early part of the season. At the end of September only twenty-six cows were in milk, compared with thirty-five in September, 1928, but production per cow last spring was much higher than that during the previous spring, due to a large extent to better pasture-growth.

Until the time of calving cows were run with the young stock to clean up the pastures after the main herd. During October, when not more than thirty milking-cows were in the herd, which meant a maximum of ten cows per acre, the primary grazing of the fields was not as thorough as it should have been, and the dry stock had difficulty in cleaning up the pastures. However, during November, Mr. Ward was able to obtain thirteen additional cows as followers to clean up the pastures after the milking herd, and with a total of nineteen followers during November better control of pastures was obtained.

Supplementary Feed.

The difficulty of providing a continuous supply of grass during the dry periods which usually occur during the summer in Auckland Province has not been completely solved at the present time. If ensilage is available it may be the means of supplementing the grass shortage to a certain extent, particularly if such ensilage is made from grass in an immature stage. During the season of 1929–30 the growth during spring was prolific, so that there was no difficulty in making sufficient ensilage on many farms, not only for immediate requirements but also as a reserve for future seasons. On Mr. Ward's farm 12 acres of grass was converted into ensilage, and during April and May some of the material was fed out to the dairy herd. With the flush of feed in February it was difficult to foresee any necessity for supplementary feeding during the autumn, but a dry spell came in the late autumn and was immediately followed by rather severe frosts. Under these circumstances, with little or no growth on the pastures, grass had to be entirely replaced by ensilage, which was fed out from 20th April until the end of May, the material being that harvested from immature grass in early November.

During the 1928–29 season, when no ensilage was available, concentrates were fed to the dairy herd, and it is considered that production was maintained to a certain extent until the flush of grass followed the advent of rains during March. An experiment to investigate the value of concentrate feeding during dry spells was carried out during the 1929–30 season. The herd was divided in December into two groups of eighteen cows in each, and, taking age, date of calving, and previous production into account, the two groups were as even as it was possible to arrange. Daily milk-yield and butterfat tests were taken from each group, and, by changing individual cows from one to the other, two groups of very even production had been selected by the

end of January. For the eleven days prior to the commencement of the experiment—from 5th to 16th February inclusive—"A" group had given 215·2 lb. butterfat and "B" group 215·4 lb.

The concentrate mixture used for the experiment consisted of 25 lb. crushed oats, 25 lb. crushed maize, 33 lb. linseed nuts, and 17 lb. bran. The nutritive ratio of this mixture is 1 to 3·6, which is a fairly narrow one.

Feeding commenced on 16th February, when Group A received 2 lb. per head per day of the above-mentioned mixture, while Group B received none. At that time there was quite sufficient grass on the farm and concentrates did not appear very necessary, but in the light of subsequent events it was not by any means too early. The ration

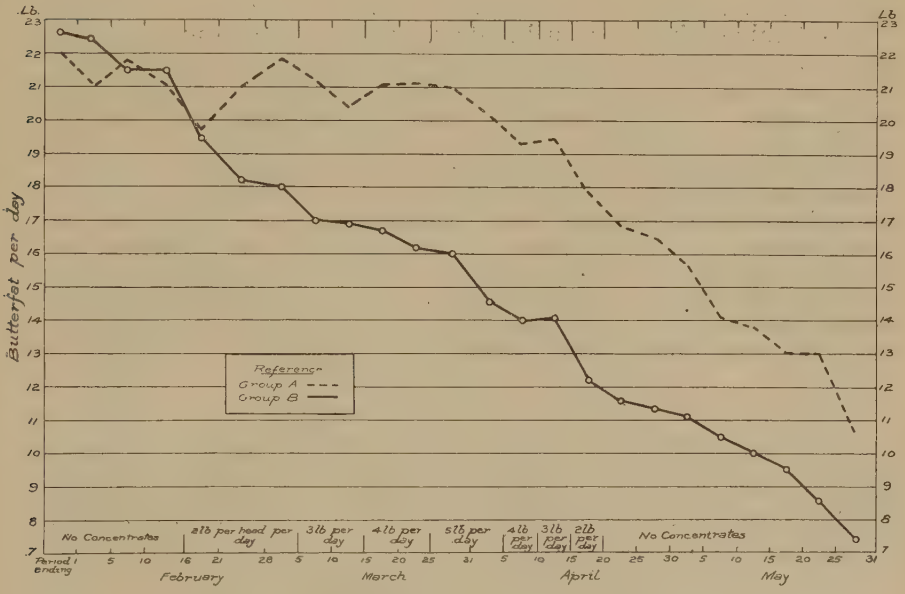

FIG. 2. GRAPH SHOWING AVERAGE DAILY PRODUCTION OF TWO GROUPS OF COWS DURING FIVE-DAY OR SIX-DAY PERIODS FROM 1ST FEBRUARY TO 31ST MAY, 1930, GROUP "A" RECEIVING CONCENTRATES, GROUP "B" NO CONCENTRATES.

was gradually increased from 2 lb. daily until 25th March, when a maximum of 5 lb. per head per day was reached. On 5th April the ration was gradually reduced, and concentrate feeding ceased altogether on 20th April.

Fig. 2 shows graphically the average daily production of the two groups during periods from 1st February to 31st May. It will be seen that following the period ending 1st February, when both herds had reached their peak, production had a downward tendency which was not immediately checked by the concentrate feeding of Group A. This was doubtless due to the difficulty in getting several cows to take the feed for a start, especially when fresh succulent grass was available in the fields. From February until the end of March, however, the production of Group A was maintained at a high level, while the production

of Group B steadily declined. After the end of March and particularly after 15th April, with the cessation of concentrate feeding, the production of Group A declined at about the same rate as that of Group B, but the margin of 4 lb. to 5 lb. butterfat per day between the two groups was maintained until the end of May, when the cows were dried off.

The main object in feeding concentrates during the dry period is to maintain production, if possible, until the flush of grass which usually appears in the autumn may be consumed by cows which are still in high production. That flush of grass, however, failed to materialize during the autumn of 1930, and the commencement of the dry period was not only unusually late but the period was also prolonged, so that there was a shortage of feed up to the time the cows were dried off. To the concentrate must be credited the extra production not only during the actual feeding, but from then on until the end of May. The extra production of Group A over Group B during this time amounted to 434 lb. butterfat. The concentrates cost £30 landed on the farm, so that at 1s. 5d. per pound the extra butterfat produced would just have paid for the cost. Unfortunately, butterfat prices during the autumn were much lower than 1s. 5d., but it must be remembered that both cost of concentrate and price of butterfat are variable and will to a large extent determine the economy of concentrate feeding. A dry spell occurring in early February followed by rains during March, conditions which prevailed during the 1928–29 season, would also be more favourable to concentrate feeding. Further investigation is needed as to the correct nutritive ratio to be used and the foods that could be most economically employed.

Butterfat Production.

During the 1929–30 season there was a satisfactory increase in butterfat production over that obtained in 1928–29, and, as will be seen from the figures of production for the last four seasons given in Table 2, there has been a steady increase each year since the experiments were commenced in 1927.

Table 2.—Butterfat Production on Mr. Ward's Farm.

Season.	Number of Fields.	Butterfat to the End of December.	Butterfat to the End of May.	Butterfat per Acre.	Number of Cows.	Butterfat per Cow.	Fertilizers.	
							Super-phosphate.	Sulphate of Ammonia.
		lb.	lb.	lb.		lb.	Tons.	Tons.
1926–27..	8	4,111	8,043	161	27	298	7½	..
1927–28..	10	5,812	10,173	203½	32	318	14	2
1928–29..	13	5,385	10,624	212½	37	287	22½	4½
1929–30..	16	5,679	11,027	220½	36	306	14½	3½

This production has been obtained in spite of difficulties which have been experienced in the form of drought in 1927, floods in 1928, and the late calving of many cows in 1929. While the latter is by no means an unusual occurrence on dairy-farms, it is generally realized that early calving is necessary for higher production. Although the past season was a good one for production, and ample feed was

available throughout the spring and summer, the shortage of cows in milk with which to convert that grass into butterfat in the early period was to some extent reflected in the output.

In the graph Fig. 3 the distribution of production for the past four seasons is shown. Figures are taken from actual ten-day periods, and in those months having more or less than thirty days the extra day has been ignored. In February two days' production, one from January and one from March, have been added. This eliminates misleading peaks when the third period in a month contains eleven days. There has been a tendency during the last two seasons for production to be more evenly spread through the season, and it has

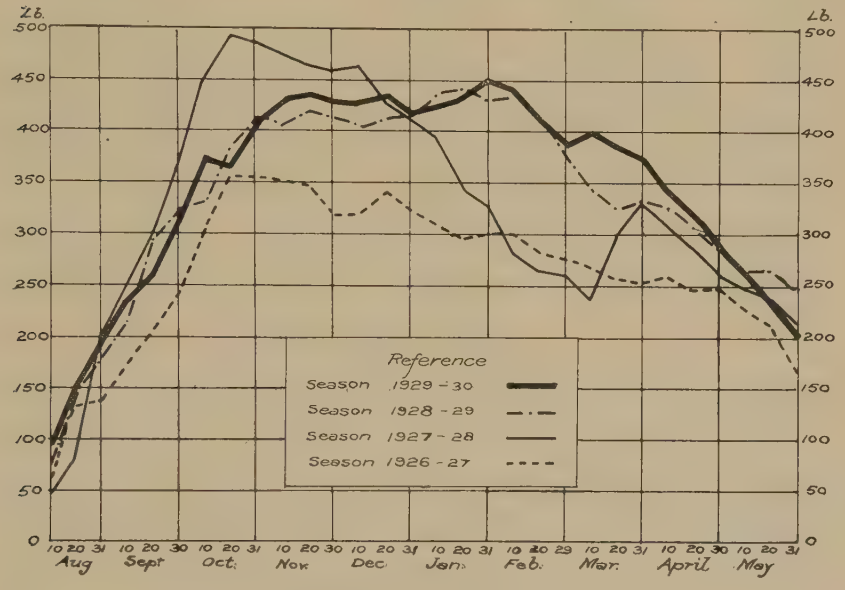

FIG. 3. GRAPH SHOWING BUTTERFAT PRODUCTION OF MR. WARD'S FARM FOR LAST FOUR SEASONS.

become evident that this will occur under a system of rotational grazing when pastures are kept under control in late spring and early summer, when a dressing of superphosphate is applied in November-December, and when supplementary feed is available for dry spells. A high production about October when feed is in abundance, with a rapid falling-off until the end of the season coinciding with the appearance of uncontrolled pasture, is generally a feature of dairy-farms under the extensive system. There is no reason why production should not be as high in October and maintained at a high level until March, or even later, on farms under the rotational-grazing system.

Summarized Points.

(1) Nitrogenous fertilizers are useful for stimulating an early spring growth of rye-grass, but the adoption of nitrogen top-dressing on many farms will not be profitable until the pastures are improved by re-establishment with truly perennial strains of rye-grass.

(2) Under rotational grazing approximately half the farm may be closed for hay and ensilage in a good season.

(3) The use of 6 cwt. of superphosphate annually, divided into three dressings of 2 cwt. per acre applied a few weeks before the extra feed is required, may be considered a satisfactory practice on intensively managed dairy-farms in this and the Waikato district generally.

(4) Concentrates may prove efficient in maintaining production during dry periods, the economic results varying with the cost of concentrate, the price obtained for butterfat, and the weather conditions following the dry period.

General.

Further experimental work is being conducted on Mr. Ward's farm during the current season. It is not intended to further subdivide the farm nor to increase the quantity of fertilizers, as it is considered that the manurial programme carried out during the 1929–30 season is, with minor modifications, satisfactory. By keeping the factors of subdivision and manuring constant it will be possible to gain valuable information on the economic aspect of intensive grazing.

Thanks are again tendered to Mr. Ward for his hearty co-operation throughout the season, and to the management of the Manawaru Cheese Factory for their courtesy in supplying figures of milk-tests.

RAISING TREES FROM SEED ON THE FARM.

State Forest Service.

In order to avoid the possibility of having to use young trees which may arrive at their destination in a heated condition, farmers and others living a long distance from supplying distributing nurseries, or at places not easily reached by rail or steamer, are recommended to procure seeds and raise their own plants.

Clean ground should be chosen, and after sowing the seeds they should be protected from birds and shaded with scrim, manuka scrub, or boughs of trees. The covering soil for conifers should not exceed $\frac{1}{4}$ in. in depth, while eucalypt seeds should be barely covered and no more—say, about $\frac{1}{8}$ in. Sowing should be done during the months of October, November, or December. In good land or in warm districts a late sowing is best, as there is then less danger of the plants becoming too large for safe transplanting. Germination will usually be completed about three or four weeks after the sowing is made. Seed (except of wattles) should be sown as received and not soaked or scalded.

A crop of trees should not exceed from 300 to 500 seedlings to the square yard of seed-bed actually occupied by the crop, and not taking into account the spaces between the beds or drills. As the germinative capacity of seed varies every year, it is possible to give only an approximate idea of the quantity required for a given number of trees without testing the seed. The accompanying table shows the average number of seedlings usually produced from 1 lb. of seed.

Name of Tree.	Quantity required per Acre for Broadcast Sowing.	Number of Seedlings usually expected from 1 lb. of Seed.	
		North Island.	South Island.
Cupressus Lawsoniana	½ lb.	20,000	..
Cupressus macrocarpa	4 lb.	5,000	5,000
Pinus radiata	1 lb.	10,000	6,000
Pinus Laricio	..	..	6,000
Pinus muricata	½ lb.	20,000	10,000
Pinus pinaster	..	..	4,000
Pinus ponderosa	2 lb.	4,500	4,500
Pseudo-tsuga Douglasii	¾ lb.	15,000	4,000
*Sequoia sempervirens**	..	1,500	..
Eucalyptus amygdalina	2 lb.	15,000	..
Eucalyptus Gunnii	6 oz.	30,000	25,000
Eucalyptus coriacea	4 lb.	3,000	..
Eucalyptus botryoides	6 oz.	30,000	..
Eucalyptus eugenioides	2 lb.	15,000	..
Eucalyptus fastigata	2 lb.	6,000	..
Eucalyptus gigantea	2 lb.	7,000	..
Eucalyptus Macarthuri	6 oz.	30,000	20,000
Eucalyptus Muelleriana	2 lb.	5,000	..
Eucalyptus obliqua	2 lb.	7,000	..
Eucalyptus ovata	6 oz.	30,000	..
Eucalyptus pilularis	4 lb.	3,000	..
Eucalyptus regnans	2 lb.	6,000	6,000
Eucalyptus saligna	1 lb.	15,000	..
Eucalyptus viminalis	6 oz.	30,000	20,000

* The number is extremely variable with this species.

The State Forest Service has for disposal large and small quantities of reliable tree-seeds, collected, where possible, from acclimatized trees in New Zealand. Imported seeds are procured from the most reliable sources. All seed is tested for germination before being disposed of, and to any one accustomed to ordinary garden-work the raising of small crops sufficient for the average farmer's requirements is an easy matter.

Sodium Chlorate and Lime-sulphur.—The Fields Division advises that spray-pumps in which lime-sulphur has been used should be thoroughly washed out prior to being used for spraying weeds with sodium chlorate. The combination of sulphur and sodium chlorate is dangerous, and may bring about an explosion.

Horse-breeding in New Zealand.—In his annual report for 1929–30 the Director of the Live-stock Division, Mr. J. Lyons, refers to this subject as follows: Prices for horses have been good—in fact, quite up to the average of recent seasons; nevertheless, the breeding of all classes of horses, with the exception of thoroughbreds, seems to be in abeyance and more or less neglected. There are still a few enthusiasts amongst Clydesdale breeders who take an interest in this class of stock. It is doubtful, however, whether enough are being bred to meet even the present demands, and if the present indifference continues it is a question whether sufficient will be reared to meet the demand for farm-work. On account of the limited number of mares being put to breeding purposes, the keeping of an entire horse has become an unprofitable proposition in many districts. Thus, because of no satisfactory sire being available, many farmers who would otherwise rear a foal or two each season are debarred from doing so. Should this condition extend it will mean that there will not be enough horses reared to meet the demand for farming purposes, and, as a certain number will still be required, those available may reach prohibitive prices.

SEASONAL NOTES.

THE FARM.

Ensilage and the Pastures.

ATTENTION was directed in these notes last month to the value of ensilage as a means not only of providing reserves of feed for use when fresh grass is in scant supply, but also of bringing about proper control of pasture-growth. Haymaking at times can be used for these same purposes, and some farmers ask why ensilage is being suggested as a preferable alternative to hay. Ensilage is often markedly more serviceable and suitable than haymaking, after making full allowance for the fact that it involves dealing with a much greater weight of material than does haymaking. Ensilage is superior to haymaking under many circumstances, primarily because it allows of surplus feed to be conserved when it should be conserved. This is because silage can be made irrespective of the weather conditions, which so often either delay haymaking or result in the loss or serious deterioration of the crop before it is saved as hay.

Conserving surplus growth when it should be done rather than when the weather permits it to be done is beneficial in three distinct ways. In the first place, the conserved material is of greater feeding value, in that there is no reason for it to be characterized by the excessive stemminess and consequent poor digestibility that characterizes much of the hay that is made. In the second place, the farmer is not forced to resort to the rush periods of work which are a feature of haymaking and which often lead to costly neglect of other important farm-work. In the third place, the pastures benefit in a dual manner when surplus growth is removed at the right time. No rank growth, with its consequent harmful opening-up of the turf, develops, and a better and more reliable aftermath can be expected when the surplus growth is removed at an early stage. These are some of the important facts that make ensilage frequently preferable to haymaking. A further advantage is that it gives reserves of feed which are practically free from damage from vermin and from fire-risk.

In addition, ensilage can at times be resorted to in order to place in reserve crops that could be satisfactorily dealt with in no other manner. For instance, the first cut from a lucerne area ordinarily becomes available each season at a time when conditions are extremely unfavourable for haymaking, and when there is nothing to be gained by giving the stock green feed in addition to that which is obtainable from the fields under grazing. Often plants other than lucerne occur freely in the first growth of each season on an area devoted to lucerne. When this is the case it is much against good future yields from the lucerne to leave the growth unmown until good haymaking weather can be expected. The only satisfactory course is ensilage. In like manner growth containing heavy quantities of weeds, such as thistles, can at times be conserved in edible form as ensilage, whereas in the form of hay the stock would not consume it.

By adopting the practice of ensilage a farmer may build up reserves of feed which could, if necessary, be fed with satisfactory results in summer as well as in winter, whereas haymaking gives a reserve which generally cannot be so satisfactorily used at both seasons. When there are reasonable grounds for expecting that silage may be utilized for the feeding of stock when they are producing milk, then it is highly desirable that the silage be made from material cut at an immature stage before there has

been much or any development of bloom. Silage made from stemmy, mature green material when fed to milking stock to supplement pastures may not be superior to hay—indeed, it may be inferior to hay well saved from material cut at an early stage.

From these merits of ensilage it is not to be concluded that ensilage should always necessarily be adopted to the exclusion of haymaking. Often, indeed, both silage and hay may well be made on the one farm; by making silage early in the season when broken weather is likely, and hay later on when good weather is likely, more surplus feed is conserved than could be done otherwise, and at the same time the labour of doing this is well distributed so that no serious dislocation of farm-routine work occurs. Summed up, the intrinsic worth of ensilage comes from the facts that it can be practised irrespective of weather, and that herbage which cannot be used satisfactorily for hay can at times be better utilized for ensilage.

Some farmers refrain from ensilage on account of the belief that it is a somewhat difficult process with which to attain success. Actually it is not at all difficult. It is less difficult than much other farm-work which is generally undertaken without hesitation; it probably calls for less skill than haymaking under average conditions. All this is rather well illustrated by the method of making the winning stack in last season's extensive Taranaki ensilage competitions. According to the report of the judge, Mr. J. M. Smith, "the crop was cut while the herbage was in a young growing condition. The material came in straight from the mower, and the stack was built to a height of 8 ft. the first day. Building was continued and completed the following day, when the stack went to a height of 15 ft., and a covering of 15 in. of soil was put on straight away. The stack was 21 ft. square." It cannot be held that there is anything intricate about such a practice. A detailed account of ensilage-making is given in Bulletin 146 of this Department.

Ensilage does not tax the labour resources of the ordinary farm if suitable modern equipment is used. Three to four workers will make really good progress with equipment which can be purchased for from £40 to £50, and which also serves excellently for haymaking. Where a suitable site for a pit is available only a portion of the expenditure just mentioned will suffice under many circumstances, and in numbers of cases a team of two workers has efficiently saved silage.

From the dependable field evidence contained in the separate article appearing in this issue it will be clear that there are grounds for the belief that ultimately ensilage will be of the great value to our sheep-farming that it is already to our dairying. Proper pasture utilization is the sphere in which many farmers show most scope for improvement. What the governor is in the working of the engine, that is ensilage in the utilizing of pastures—control.

The smaller the amount of silage saved the greater is the proportion of waste. Hence it sometimes becomes advisable to ensile together material from several sources. For instance, in the early part of the season by conserving together surplus material from pastures, from green cereals, and from lucerne, many farmers would have a much more satisfactory bulk of material to work with than would be the case were each crop treated separately.

Other Pasture-work.

Topping of the pastures with a mower to remove rank growth should often be carried out in November. Many farmers do this work too late. If it is done in November it is a reliable means of increasing the late summer and autumn development of fresh leafy pasture-growth which is so often in scant supply.

Harrowing of pastures in November is frequently needed, principally for the purpose of breaking up animal droppings. To distribute such droppings thoroughly it is often well to harrow up and down in one direction instead of round and round a paddock, and then to give a second stroke of the harrows at right angles to the first one.

Supplementary Forage Crops.

Mangels.—Of the mangel, which generally may be sown in October or November, it is important to remember that success comes only from good treatment. If it is not grown under conditions providing high fertility and thorough cultivation—to which in combination it responds fruitfully—disappointing yields may be depended upon. Hence for the mangel if a good soil is not available, then fertility should be built up by free use of fertilizer. A mixture of equal parts of superphosphate and bonedust supplemented by 2 cwt. of kainit or agricultural salt will over wide conditions give good results. The kainit or salt will fairly readily cause seedling injury if brought into proximity with the germinating seed, and so should generally be broadcast before seed-sowing. At times depressed yields follow the sowing of mangels before the soil is warm enough. This is particularly likely to occur on land which is not thoroughly drained.

Turnips and Swedes.—The main sowing of turnips and swedes ordinarily takes place in November, but where grass-grub damage is apt to be serious, as at times is the case in Canterbury in particular, then the special measures mentioned in a subsequent paragraph need to be considered. That seed-injury is likely to take place when the seed of any of these crops is mixed with superphosphate, even at a short time prior to sowing, is fairly generally known, but it is doubtful whether some realize how serious this injury is likely to be. A reduced germination may also be caused by contact between seed and such manures as dried blood, potash salts, and sulphate of ammonia. Purple-top Mammoth, Red Paragon, and Green Globe are standard turnips of proved merit.

Carrots, which demand thorough cultivation, thrive best in a free loam, but may be grown satisfactorily on a wide range of soils. Matchless White and White Belgian are deservedly probably the most popular varieties. If the area of the crop is too large to allow of hand cultivation, carrots should be sown in drills 21 in. to 26 in. apart; whereas if hand cultivation is contemplated drills 14 in. to 18 in. apart are suitable, using about 1 lb. of seed per acre. When carrots are to be fed to sheep, Guerande is the most suitable variety. This variety should be sown in drills 21 in. to 28 in. apart, at the rate of 1½ lb. seed per acre; it should be intertilled but not thinned. Carrots may be sown in November, and generally respond profitably to dressings of 2 cwt. to 3 cwt. of an artificial fertilizer of which superphosphate and bonedust are the principal constituents.

Maize and Millet are useful for green feed particularly in districts where rape does not thrive. Both crops demand warmth and sometimes are sown earlier then is advisable. In many parts they should not be sown before the last week in November or the first part of December.

During spring and early summer it is of value as a means towards saving of labour to keep in mind constantly that plants are in a critically delicate condition in the seedling stage. Hence weed seedlings should be attacked at this stage. When relatively small seeds, such as lucerne or carrots, are to be sown it is well to destroy by suitable cultivation crops of weed seedlings which appear prior to sowing, and to attack as soon as possible such weed seedlings which develop after sowing the crop.

Lucerne.

Lucerne is similar to the mangel in that it calls for warm germinating conditions. There is nothing to be gained by sowing it somewhat early

when the soil is still cold. Under many conditions November or December is quite early enough. Opportunity should be taken of the intervening period to destroy by suitable cultivation any crops of weed seedlings that develop. Another important matter in lucerne-establishment is soil inoculation. Unless the soil is provided with the particular micro-organisms with which lucerne co-operates, to the mutual advantage of both, then failure with the lucerne will follow. There is open to the farmer no practicable way of discovering before growing the crop whether his soil is inhabited by the requisite organisms. This being so, the safest course is to provide the organisms. Supplies of the necessary organisms are provided free of charge by this Department. How to obtain these supplies and how to use them may be learnt by applying to local officers of the Department of Agriculture.

Lucerne requires a well-prepared seed-bed, fine and firm. Generally lime may advantageously be applied at the last cultivation and disked in. It is important to remember that serious harm results from sowing lucerne-seed with superphosphate—the soil-inoculating organisms are destroyed. Marlborough and Hunter River strains are usually the most satisfactory seed. In the drier parts of the South Island 10 lb. to 14 lb. of seed per acre, sown in drills 7 in. apart, is usually enough, while in the wetter parts of the Dominion 15 lb. to 18 lb. is usually sown.

Established fields of lucerne generally require to be mown during November. As flower-development is at times unduly delayed in the spring the most reliable indication of when mowing should be done is frequently the appearance of fresh shoots at the base of plants. Because of weather conditions it is usually well to arrange for the first cut of the season from a lucerne area to be made into silage.

Precautions against the Grass-grub Beetle.

Over extensive areas the main flight of the beetle of the grass-grub occurs between mid-November and mid-December. Because of this, in districts where the grub is prevalent it may be sound practice to so delay the sowing of crops such as turnips and swedes that the seedlings will not have appeared above ground when the main beetle-flight occurs. This may mean the sowing of such crops at approximately Christmas-time in order to avoid the seedlings being destroyed by the beetles. Another point arising out of the flight of these beetles is that they will not deposit eggs on ground devoid of herbage. Hence, land which is to be sown in new pasture or in lucerne may sometimes with advantage be kept bare when the main beetle-flight is expected.

—R. P. Connell, Fields Division, Palmerston North.

Precautions at Shearing-time against Caseous Lymphadenitis.

When the sheep have been mustered for shearing, each animal should be examined carefully for the presence of enlarged glands or ruptured abscesses, and all those in which enlarged glands are detected should be set aside. These sheep should be kept back and not shorn until after all the rest of the flock. In shearing them special care should be taken to apply disinfectant to all wounds inflicted. They should preferably be blade-shorn, and the shears should be frequently dipped in an antiseptic fluid. One part of non-poisonous dip in thirty of water, or, alternatively, kerosene alone or equal parts of tincture of iodine and water answers this purpose.

Every wound made during the shearing of the apparently unaffected sheep, as well as those on affected ones, should be carefully disinfected. This can be done by using one or other of the above-mentioned antiseptics. Stockholm tar is in common use and is good from the disinfectant viewpoint.

It, however, clings to the skin, and later, to the growing wool, and is liable to thereby depreciate the wool from the manufacturers' standpoint.

Shear blades should be cleaned and disinfected frequently. This is easily done with blade shears, but owing to the oily accumulation liable to be present upon them machine shears are not so easily disinfected.

It is a wise and desirable precaution to saturate the soil of the yards with a strong antiseptic solution—say, one part of non-poisonous sheep dip to twenty parts of water.

In regard to the examination before shearing, the infected glands are almost invariably found at the front of each shoulder and in the fold of each flank. They can be readily detected, though the shoulder glands are a little below the surface of the skin. Not only must enlarged glands be sought by careful handling, but the skin and wool at these parts should be examined in order to detect the scars left by ruptured gland abscesses and collections of matter in the wool derived from these ruptured abscesses.

—*Live-stock Division.*

THE ORCHARD.

Spraying Points.

DURING October spraying for the control of diseases should take precedence over all other activities in the orchard. The germination of fungus spores will be taking place rapidly under the influences of rising temperatures and atmospheric humidity, and young fruit will become exposed and develop rapidly in size, thereby increasing the field of infection. It should be borne in mind that the end of this month, generally speaking, terminates the period during which the more concentrated spray-solutions can be applied with safety, and that the maintenance of the orchard free from infection by fungus diseases at the commencement of the season has a valuable influence up to the close of the growing-period. This statement also applies to the control of those insect pests the broods of which come forward in the early part of the season. "Prevention of increase and limitation of distribution" should be the slogan of all commercial fruitgrowers, this referring particularly to red-mite and apple leaf-hopper, both of these insects appearing as nature provides the foliage for their sustenance.

Last month's notes dealt with suitable spray programmes for the control of the principal fungous diseases and pests, but apple-leaf hopper was not included. For the information of readers whose orchards are subject to infestations of this insect it may be mentioned that at the nymph stage the activity of the insect is much restricted, and in consequence control is more easily effected. An application of emulsified oil 1–150 plus Black Leaf 40 1–800 will give a 100-per-cent. kill of those insects which come into actual contact with the solution. Thorough application of the spray, so that the under-surface of all foliage is wetted and no detail is missed, makes this possible.

Fireblight.

Careful watch in both infested and non-infested areas for the occurrence of this bacterial disease is a duty on the part of all orchardists in the interests of themselves and the industry as a whole. Primary infection becomes obvious with the blackening and withering of the blossoms, and later results of infection may be observed by the oozing of sap from the cankers following the breaking down of wood tissues in the limbs of the trees. The only means recognized as providing satisfactory control is that of cutting away (well outside the area infected) and destroying by burning all diseased parts. The diseased part of the tree is defined by discoloration of the cambium layers. In cases of tip or blossom infection removal should

take place at least 6 in. below discolored tissue, and in the case of large cankers on the main branches removal of the entire limb can be recommended. This somewhat drastic precaution is desirable in order to avoid the retention of infected surfaces over which ooze may have passed and which has become unnoticeable by drying off.

In addition to attention to the fruit-trees, it is of vital importance to fruitgrowers that all hawthorn growing in the vicinity should be kept under observation. Flowers should be closely examined during the blossoming period, bearing in mind that infection in the first instance may be comparatively localized, and that it is within the range of possibility to stamp out initial outbreaks of the disease.

Thinning of Fruit.

This work is of great value in the elimination of disease-infected fruit, together with regulation of the size of fruit and quantity of crop. The results of systematic thinning are far-reaching, not only improving the crop for the current season, but determining in most instances the growth of the tree and subsequent development of the fruit-buds for the succeeding year. It is not always an economic proposition to thin large stone-fruit trees, and such being the case severe cutting out of fruiting wood during the dormant season should be resorted to, especially in the case of peaches, nectarines, and Japanese plums. Heavy cutting out of fruiting wood may appear a sacrifice at the time, but it is in most cases a really good investment in fruiting wood for the following season.

In thinning apples and pears, growers must be guided by the general condition of the trees. Robust trees likely to maintain their growth and size of fruit may be left with three fruits to the cluster; others with less constitution should be thinned to two or even one fruit, according to vigour and variety. Generally short-stemmed spur-bearing varieties require more drastic thinning than long-stemmed lateral-bearing varieties, having in mind that opening-up of the clusters restricts the shelter and security afforded such insects as bronze-beetle and leaf-roller caterpillar.

Care of Grafts.

Results of reworking will become apparent towards the end of this month. Where failures have occurred it is not too late to retrieve the position by an addition of more scions, provided the wood has been kept dormant by complete burial in damp sand and stored in a cool place. Growth which arises from the cut-back branches should not be entirely removed until the following dormant pruning, pinching only being practised where the growth is likely to submerge the scions. Growths arising from the stocks have a definite value in the maintenance of excitement to the roots.

Cultivation.

The harrows should now be used to conserve all moisture obtained from the spring rains and to kill weed seedlings. In heavy soils this work is best carried out when the soil is damp but not wet.

—M. Davey, Orchard Instructor, Mapua.

Citrus Culture.

As stated in the last month's notes, a good deal of damage had taken place in some of the citrus plantations owing to severe winter frosts. As a result lemons that had been damaged have been placed on the market, probably by less experienced growers. This practice is not in the best interests of the industry. Fruits that have been damaged by frost are almost useless, and should not on any account be offered for sale. It is far better to accept the loss, cut the fruits from the trees, and have them

destroyed, otherwise a period of low prices for the locally-grown lemon is likely to be caused. A ready market can usually be found for all fruits of good quality and appearance, and it is in the interests of the industry as a whole that every effort be made to eliminate all inferior or low-grade fruit.

Diseases.—This is a matter that will now have to receive attention from all who take an interest in producing clean fruit. Soon after the main crop of blossoms have fallen the trees should be given a spraying of bordeaux 4–4–40 for the control of verrucosis. The lemon-tree flowers over an extended period, and needs to be continually under observation and repeated applications given as required in order to keep the whole crop clean and free from disease.

A sharp lookout should be kept for any borer that may be making its appearance. Where only small branches are affected it may be the best practice to cut them out and burn them. With large branches a little benzine can be injected into the hole, and the hole then plugged with soap, putty, or clay.

As soon as the young growth commences a watch should be kept for red scale and thrips, as they soon become very troublesome. The trees should be sprayed with red-oil 1–40 to 1–60. The question of the strength will depend somewhat upon the vigour and health of the tree. Where trees are more or less debilitated the application made should be weaker than that given to trees in a more vigorous and healthy condition.

Cultivation.—When soil conditions are favourable all cultural operations should be carried out as they are required. Neglect in carrying out any one operation at the correct time may in a measure nullify what is done in other directions. —*L. Paynter, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

Economy on Right Lines.

TAKING into consideration the present high cost of foodstuffs and the low prices ruling for eggs, with the consequent reduced margin of profit over the cost of production, emphasis must be laid on the necessity for good management and for economy in every phase of the poultry business. It is the strict attention to small details that counts mostly in poultry-keeping, and which generally makes all the difference between success and failure.

While economy should be practised in every respect there must be no stint in the quantity of food supplied, which is too often the case when food costs are high and low egg prices prevail. Instead of reducing the food ration the flock itself should be culled whenever possible. In the first place, a saving can be effected by marketing at once any old hens which give evidence of having passed their best period of usefulness. It must be admitted that the work of culling, at this season of the year requires considerable judgment, or the good layer is apt to be discarded and the poor one retained in the flock. The heavy layer will usually be found to be in a more or less active, lean condition, while the birds possessing the greatest weight and well above the standard weight of their breed are the drones. The condition of the abdomen also is usually an indication of a bird's laying-capacity. In the heavy layer at this period of the year the abdomen will be found to be well developed, soft, and yielding to the touch, while in the poor layer its condition will be the reverse, indicating that the bird is turning the bulk of its food into surplus flesh and fat instead of into eggs.

There is nothing to gain but much to lose in allowing broody hens to sit on the nests for days or even weeks at a time. Not only does this

mean a serious loss in eggs, but it encourages the presence of vermin, and it is a fallacy to imagine that by giving the birds a rest in this manner at this time of the year they will come on to lay in the winter months. Such birds will generally moult with the other members of the flock at the usual moulting period.

Some persons resort to extremely cruel methods to put a hen off its broodiness—for instance, by confining it in a coop without food and water, or by dipping its head under water until it is nearly drowned. The best plan is to confine the hen in a coop with a slatted or wire-netting bottom, the coop being raised clear of the ground by means of two legs at each end. If a bird is removed from her usual surroundings on the first sign of broodiness she will soon lose her desire to sit. Broody hens should be given an ample supply of good nourishing food, in order to induce activity of the ovaries and a resumption of egg-laying in the shortest time possible.

Unsuitable Meat-and-bone Meal.

A poultry-keeper recently informed me that he purchased a line of meat-and-bone meal, and that in the hope of promoting egg-production he fed some of this material in the morning mash—with disastrous results. Not only did the egg-yield decline, but several of his birds died. On request, some of the meal was forwarded for examination. Not only did it possess a decidedly objectionable odour, but its general appearance gave ample proof that the mixture had been prepared for fertilizer purposes, and not as a food for poultry. This is not the first complaint received relative to mortality in poultry stock due to meat-and-bone mixtures manufactured for manurial purposes. It should be remembered that when meat-meal, or bone-meal is spoken of as a food for poultry, this applies only to the commodity which has been specially prepared as a food for stock, and to include such meal material of doubtful quality in a mash for fowls is simply inviting trouble. If fowls are to do their best it is of first importance that they be provided with palatable food.

Determination of Age of Ducks.

I have been asked how to ascertain definitely the age of a duck, but so far as I am aware there is no means by which this can be done. The condition of the windpipe, however, is a good guide as to whether or not a bird is an old or a young one. If the windpipe is hard to the touch it is safe to say the bird has passed the duckling stage. On the other hand, if the windpipe is soft and yielding it indicates that the bird is comparatively young. In applying this test to a live bird care must be taken that the windpipe is not squeezed to the extent of injuring the bird. In the case of a dead duck the condition of the upper part of the bill also gives a good indication of its age. In a young bird the bill can be pressed back and easily broken, while with an old one this will be found a difficult matter unless great pressure is used. Another method of deciding between an old and a young bird is the manner in which the breast-bone can be pierced with, say, a sharp hat-pin. With a young bird the bone can be pierced quite easily, but in the case of an old one considerably more pressure is required.

Lawn Clippings.

Lawn clippings, when they are short and in a succulent condition, make an ideal green food for fowls. On the other hand, if they are long and fibrous they are apt to form a tangled mass and will not leave the crop or gizzard, often resulting in heavy mortality. This applies particularly when the birds are not well supplied with sharp gravel grit.

Cleanliness.

Success in poultry-keeping depends to a large extent upon the manner in which its many details are attended to, but one which must be specially

acted upon is that of cleanliness. Many people have no idea of what cleanliness really means; they seem quite unconcerned if they become covered with vermin every time they enter the fowl-house, even if it is only to collect the eggs. Even where there are apparently no vermin present in the house, it is always a wise plan as a preventive to adopt the same measures as if they were present.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

Artificial Increase.

ARTIFICIAL increase may be accomplished in several ways, but perhaps the most satisfactory are those by means of nuclei and division. A nucleus is best formed of two frames of emerging brood and young bees, one frame of honey, and one containing pollen. This must be completed by a virgin queen or a ripe cell. The nuclei may be utilized throughout the season for mating of queens for renewal, and at the end of the summer—if two or more are united, or if each one is reinforced by the addition of bees and brood from strong colonies—they may be wintered in safety and will form good stocks for the next season. No surplus can be expected from them the year of their installation.

In dividing it is best to wait till the colony is preparing to swarm and ripe queen-cells appear in the hive. The hive can then simply be split in two by putting half the bees and brood on another stand, taking care to leave queen-cells in each division, and for preference putting as much emerging brood in the half which is to be placed in a new position. This latter precaution is necessary in order to make up the wastage from the field-bees that will return to the old stand. Each hive can then be completed by filling the vacancies by drawn-out combs. The queen-cells in the queenless half will be nursed by the young bees, while those in the half containing the queen will be torn down by the bees when they find the hive depleted. If the apiarist wants to be quite sure of this being done he may search for the queen and remove her while the division is being made, afterwards putting her in the hive on the new stand.

The division method is advocated on account of its simplicity and the fact that there is no necessity for finding the queen before the operation. It is a most effectual preventive of swarming, and saves a great deal of trouble where increase is desired.

Supering.

In most districts November is early enough for the employment of supers, though much depends on weather conditions. If the weather is warm, the hives full of bees, and nectar coming in freely, the supers may now be added to at any time. However, it is of no use discouraging the bees by giving additional space before the weather is warm enough to justify it. If increase is required it is as well to confine the bees to one story till the hive is overflowing with bees. This is almost certain to produce a desire to swarm, and the hive can either be allowed to swarm naturally or be divided artificially.

When the first super is put on it is best, if possible, to fill it entirely or partially with drawn-out combs. If only foundation is available, one or two combs—not containing brood—may be removed from the bottom story to the top, and sheets of foundation put in their place. On no account disturb the brood until settled weather eventuates. If foundation is used in the super, queen-excluders should not be used, as the bees will rarely travel through the excluders to work the foundation, and will usually swarm. Do not bring excluders into use until the bees are quite accustomed to working in the supers.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

The Strawberry Crop.

THE strawberry crop will soon be ready for harvest, when, accompanied by castor sugar and cream, it will doubtless soon win its usual high position in the general estimation of the public. To win and maintain this position the greatest care is needed in picking, packing, and despatch, so that the fruit is widely distributed and presented in a fresh appetizing manner. It is then without a rival in its class for a considerable period.

In all the operations of fruitgrowing, picking the crop often demands more consideration from the operator than any other, a fact it is well to clearly realize when engaging assistance and supervising the work. It is usually the picker's business to gather *all* mature fruit, place the culinary fruit in special receptacles, and pack the dessert fruits neatly and fairly in punnets, which must be held in a cool place until they are promptly consigned to their destination. Such work demands unusual application and intelligence from the operator and constant supervision by the grower in order to obtain the best financial returns. Goods that are stale and stained, mixed in quality and maturity, and, worse still, topped off with fruit of a much higher quality and size, do a very great amount of harm to the trade by diminishing consumption.

Overripe berries, however fine, should be excluded from shipments consigned over long distances. Undersized and defective berries should be placed aside for culinary use, and crops affected with brown-rot fungus should never be sent to distant markets. The wonderful display of choice fruit of this kind arriving at the markets is a strong contrast to the careless packing and shipping of goods which are slow in selling and disappointing to the unwary buyer.

Strawberries should be picked when they are dry and cool. The stage of ripeness should be considered in relation to the state of the weather and the time taken to reach the market. They should be firmest for shipping a long distance in hot weather, while for a nearby market in cool weather the ripening process may be almost complete. Dessert berries are picked with a stem $\frac{1}{4}$ in. long, and placed in the punnet in a compact manner, so that when they reach their destination the punnets are still full. If they have shaken down they are probably bruised, and even when filled up by the retailer are a disappointing "buy."

Other Small Fruits.

The season for gooseberry-pie also now commences, and it is a welcome addition to the short list of fresh fruit which is now available. The only hopeful suggestion in the marketing of gooseberries that may be made is probably one relating to sizing. It is not uncommon to see a wide range of sizes in a consignment, which would be much more attractive if it were put through a riddle and the two sizes packed separately.

Raspberries and currants will require occasional hoeing and cultivation to suppress weeds, but it should be done with care to avoid disturbing the fibrous roots which are very near the surface.

In the preparation of the land for planting small-fruits in the autumn or winter, a preliminary crop of some vegetable put in now is a profitable and satisfactory method, if care is taken to thoroughly clean the land meanwhile.

Tomatoes.

Where tomato-plants are to be planted outside they should be well watered in the boxes a day or so before removal. Manures commonly used before planting this crop are bonedust, superphosphate, and potash. The bonedust is generally best turned in deep, but the more soluble manures may be drilled in the rows a short time before planting out. The quantity required will depend on the quality of the soil, previous manurial treatment, and cropping; but in consideration of the excessive quantities often applied it is appropriate to observe that these good things when used to excess are very injurious to the plants and a waste of money.

Under glass without artificial heat the tomato crop now commences to ripen. In the drier localities it is customary to mulch down the surface with strawy stable-manure at this stage. It keeps the ground moist without getting sticky, and feeds the plants just when they require it. In damper localities this mulch is not used. But in either case feeding the plants fortnightly with liquid manure is now advisable to fill out the fruit and give it a good appearance. Nitrogenous manures which have been avoided up to the present may now be included, as growth is sufficiently advanced for this to be done with safety. Removing the lower leaves now to just beyond the bottom bunch, and carrying them out and destroying them, has many advantages, one being the facility it provides for the circulation of air through the crop.

Market-gardening.

Thinning and hoeing sums up the most important work for many crops at this season. Medium and even size in root crops, &c., is most desirable for market purposes. This may be obtained by suitable spacing and an intelligent use of manures. For this reason these two operations of hoeing and thinning are of paramount importance now. Hoeing weeds, in the seedling stage, during bright weather is a quick and easy method of destroying plant pests that might easily cause disaster. Thinning is best done in dull weather or at least when the ground is moist. Shortly after the operation is completed a light dressing of sulphate of ammonia is often beneficial.

Consideration should now be given to the preparation of the land for winter crops of leeks, savoys, cauliflower, broccoli, &c., which are planted out early in the New Year or even earlier. It is sometimes satisfactory to plant them out between the rows of early peas and potatoes.

In districts where late frosts threaten first sowings of cucumbers, marrows, and other gourds, the paper caps used for such crops in some parts of the United States might well be tried. Glassine or waxed papers 16 in. by 18 in. in size are placed over each sowing. The paper is supported by an arch 4 in. high of galvanized wire and secured round the edges with soil. When the plants are about 1 in. high they are thinned, cultivated, and the cover replaced. Later, when the temperatures are safe, the cap is lifted on the lee side, so that the plant gets more air and is hardened off in preparation for the complete removal of the covers later.

Sowings this month consist chiefly of swedes and salads. Although it is not exactly a market vegetable at the present time, New Zealand spinach might well be sown now for home use. It is of special value in districts which experience a dry summer. Under such conditions it provides a green vegetable of good quality and quantity when other kinds are most difficult to grow. In Europe it is highly esteemed for this purpose, and is sown in light soil in a sunny position so that when

established the plants are 3 ft. apart in each direction. It should be well watered in dry weather, when it will provide generously the tender shoots which are used.

The cutting season for asparagus ends during November, and many authorities consider that is the best time to manure the crop. A moderate dressing of equal quantities of potash, superphosphate, and nitrate of soda would be a suitable dressing in many instances.

The Homestead Garden.

Good progress is being made in the cultivation of our native plants, but the best results are only obtained when they are given a suitable soil and situation and grouped effectively. Very noticeable at the present time are the large groups of Chatham Island lily growing in moist, semi-shaded situations, where they are generally the picture of healthy vigour. The large handsome leaves, with four to five flower-stems to the plant, promise to make an even finer display as soon as the blossoms open.

Rhododendrons, azaleas, and heaths are greatly invigorated now by the removal of the old flower-heads with the seed they contain. Early attention of this kind will greatly improve the blossom next season. Delphiniums and other herbaceous plants should have the young growth thinned and neatly staked.

—W. C. Hyde, Horticulturist, Wellington.

AGRICULTURAL SHOWS, SEASON 1930-31.

THE following show-dates have been notified by agricultural and pastoral associations :—

Hawke's Bay A. and P. Society : (**Royal Show**), Tomoana, 21st to 23rd October.
Poverty Bay A. and P. Association : Gisborne, 28th and 29th October.
Wairarapa A. and P. Association : Carterton, 29th and 30th October.
Timaru A. and P. Association : Timaru, 29th and 30th October.
Marlborough A. and P. Association : Blenheim, 31st October and 1st November.
Manawatu A. and P. Association : Palmerston North, 5th, 6th, and 7th November.
Northern A. and P. Association : Rangiora, 7th November.
Wanganui A. and P. Association : Wanganui, 12th and 13th November.
Canterbury A. and P. Association : Christchurch, 13th and 14th November.
Egmont A. and P. Association : Hawera, 19th and 20th November.
Stratford A. and P. Association : Stratford, 26th and 27th November.
Otago A. and P. Society : Dunedin, 26th and 27th November.
Nelson A. and P. Association : Richmond, 28th and 29th November.
Wyndham A. and P. Society : Wyndham, 5th December.
Southland A. and P. Association : Invercargill, 9th and 10th December.
Helensville A. and P. Association : Helensville, 29th January, 1931.
Feilding A. and P. Association : Feilding, 3rd and 4th February.
Masterton A. and P. Association : Solway, 17th and 18th February.
Te Awamutu A. and P. Association : Te Awamutu, 18th February.
Marton A. and P. Association : Marton, 25th February.
Auckland A. and P. Association : Auckland, 26th, 27th, and 28th February.
Katikati A. and P. Association : Katikati, 3rd March.
Taranaki Agricultural Association : New Plymouth, 4th and 5th March.
Waikato Central Agricultural Association : Cambridge, 4th and 5th March.
King Country Central A. and P. Association : Te Kuiti, 12th March.
Mayfield A. and P. Association : Mayfield, 14th March.
Methven A. and P. Association : Methven, 28th March.
Oxford A. and P. Association : Oxford, 2nd April.

Wool-production. — The total production of wool in New Zealand for the season 1929–30 is estimated at approximately 250,000,000 lb., as compared with 239,000,000 lb. for 1928–29.

ANNUAL SHEEP RETURNS AS AT 30TH APRIL, 1930.

TABLE I.—SUMMARY BY SHEEP DISTRICTS.

Class.	Auckland.	Napier-Gisborne.	Wellington-West Coast.	Marlborough-Nelson-Westland.	Canterbury-Kaikoura.	Otago (including Southland).	Total in Dominion.
Stud rams entered (in flock-book)	1,282	1,198	3,521	834	3,536	3,877	14,248
Other rams	47,069	100,660	89,028	19,610	88,150	89,852	434,369
Wethers	464,012	656,259	723,766	243,293	561,665	718,921	3,367,916
Breeding-ewes	1,865,690	3,858,525	3,588,246	809,400	3,663,071	3,779,243	17,564,175
Dry ewes	86,094	281,071	203,781	57,836	231,375	217,515	1,077,672
Lambs	861,125	2,039,842	1,664,744	395,543	1,504,245	1,917,408	8,382,907
Totals, 1930 ..	3,325,272	6,937,555	6,273,086	1,526,516	6,052,042	6,726,816	30,841,287
Totals, 1929 ..	2,734,171	6,795,339	6,058,934	1,456,952	5,827,573	6,178,413	29,051,382

TABLE II.—COMPARATIVE STATEMENT: TEN YEARS, 1921–30.

Year.	Stud and Flock Rams.	Stud Breeding-ewes.	Stud Dry Ewes.	Stud Lambs.	Total Stud Sheep and Flock Rams.	Sheep of Distinctive Breed not entered in Flock-books, and Crossbred Sheep.				Grand Total, Stud and other Sheep.
						Wethers.	Breeding-ewes.	Dry Ewes.	Lambs.	
1921	322,144	158,608	9,513	110,428	600,693	3,634,799	11,989,180	1,336,306	5,724,053	23,285,031
1922	322,072	154,277	7,259	98,221	581,829	2,727,624	12,341,777	952,789	5,618,240	22,222,259
1923	330,055	172,843	9,013	119,749	631,660	2,551,627	12,890,160	808,919	6,199,073	23,081,439
1924	332,814	179,533	9,727	132,137	654,211	2,807,832	12,896,561	1,036,723	6,381,249	23,775,776
1925	355,579	184,744	7,867	131,485	679,675	3,063,663	13,530,479	875,899	6,398,239	24,547,955
1926	370,535	192,055	10,053	138,526	711,169	3,212,435	13,756,197	1,069,682	6,155,510	24,904,993
1927	388,274	199,219	8,644	144,897	741,034	3,074,974	14,632,511	823,047	6,377,450	25,649,016
1928	396,351	205,720	7,347	145,969	755,387	3,024,647	15,328,331	861,780	7,163,653	27,133,810
1929	422,331	219,802	7,203	156,526	805,862	3,289,135	16,388,353	875,495	7,692,537	29,051,382
1930	448,617	244,480	7,884	174,862	875,843	3,367,916	17,319,695	1,069,788	8,208,045	30,841,287

TABLE III.—DISTRIBUTION OF THE VARIOUS BREEDS, AND OF CROSSBREDS, IN EACH SHEEP DISTRICT (1930).

Breed.	Auckland.	Napier-Gisborne.	Wellington-West Coast.	Total in North Island.	Marlborough-Nelson-Westland.	Canterbury-Kaikoura.	Otago.	Total in South Island.	Total in Dominion
Stud sheep (entered in flock-book)—									
Merino	21	17	..	38	7,467	13,148	7,690	28,305	28,343
Lincoln	666	1,175	6,208	8,049	366	183	347	896	8,945
Romney	21,123	18,145	90,881	130,149	11,179	5,999	53,302	70,480	200,629
Border Leicester	1,030	..	381	1,411	323	13,453	10,826	24,602	26,013
English Leicester	2,796	244	225	3,265	1,844	21,363	987	24,194	27,459
Shropshire	373	..	306	679	61	2,853	999	3,913	4,592
Southdown	5,811	12,865	38,919	57,595	1,627	19,020	3,082	23,729	81,324
Corriedale	538	134	1,030	1,702	1,067	39,175	13,454	53,696	55,398
Ryeland	1,076	696	592	2,364	33	1,291	196	1,520	3,884
Other breeds	300	..	68	368	1,517	2,555	447	4,519	4,887
Totals	33,734	33,276	138,610	205,620	25,484	119,040	91,330	235,854	441,474
Sheep of a distinctive breed, but not entered in flock-book—									
Merino	12,556	12,275	19,109	43,940	211,900	495,871	408,560	1,116,331	1,160,271
Lincoln	7,660	32,864	16,818	57,342	9,258	7,103	5,005	21,366	78,708
Romney	441,412	1,486,236	1,037,547	2,965,195	147,591	103,017	413,486	664,094	3,629,289
Border Leicester	5,358	4,399	1,811	11,568	1,016	23,599	24,518	49,133	60,701
English Leicester	4,399	1,526	188	6,113	9,168	37,560	6,515	53,243	59,356
Shropshire	2,197	291	1,417	3,905	2,425	6,758	3,224	12,407	16,312
Southdown	14,946	29,006	58,281	102,233	1,873	23,204	12,151	37,228	139,461
Corriedale	3,710	24,710	18,852	47,272	34,706	678,003	434,934	1,147,643	1,194,915
Half-bred	6,386	1,097	2,059	9,542	266,090	721,082	341,708	1,328,880	1,338,422
Ryeland	605	414	288	1,307	1,993	2,000	235	4,228	5,535
Other breeds	1,246	1,103	1,541	3,890	9,139	13,519	30,308	52,966	56,856
Totals	500,475	1,593,921	1,157,911	3,252,307	695,159	2,111,716	1,680,644	4,487,519	7,739,826
Crossbreds and others not otherwise enumerated	2,791,063	5,310,358	4,976,565	13,077,986	805,873	3,821,286	4,954,842	9,582,001	22,659,987
Grand totals ..	3,325,272	6,937,555	6,273,086	16,535,913	1,526,516	6,052,042	6,726,816	14,305,374	30,841,287

WEATHER RECORDS: SEPTEMBER, 1930.

Dominion Meteorological Office.

AFTER a severe winter August appeared to give promise of a return to milder conditions. September, however, brought a set-back, and another cold and stormy month was experienced. The tendency for subnormal temperatures which has been in evidence for over a year past therefore continues. The cold spell between the 6th and the 12th was responsible for considerable losses of lambs, especially in Hawke's Bay, the Wairarapa, and Canterbury. In the ranges of the South Island the snowfalls generally were not very heavy, so that the losses were not so serious as on the lower country where the effect of the cold was increased by the high precipitation. The growth of vegetation was retarded and the season is in a somewhat backward state. Nevertheless, stock, crops, and pastures are reported as mainly in fair condition.

Temperature: At Wellington and Christchurch last month was the coldest September recorded, while at many other places the only one with a lower mean temperature was that of 1925.

Rainfall: This was above normal in the district from Whangarei southwards to Auckland and Thames, in the eastern portion of the North Island from East Cape to Wellington, and on the high Central Plateau, and in Canterbury and Otago. Elsewhere, it mainly was below normal. The excesses were considerable in parts of Hawke's Bay, Canterbury, and North Otago. In most districts where a deficit was recorded it was of a considerable magnitude also, while the areas round Nelson and Blenheim had a very dry month.

Pressure: The mean pressure was considerably below the September average.

Sunshine and cloudiness: The month was a cloudy one in most districts, and the total amount of sunshine recorded was unusually low.

Winds: The month, on the whole, was a windy one, especially in the northern half of the North Island and in eastern districts generally. There was a persistent tendency for low pressures to the east of New Zealand, while over eastern Australia high pressures prevailed. The result was that once more there was a high proportion of southerly winds. During the period from the 23rd to the 28th weather of the westerly type ruled and conditions were mild.

Weather and storm systems: In many parts the month was a showery one, with the rainfall fairly uniformly distributed. No very general rains were experienced, and such heavy falls as were recorded came at different periods in the different districts.

The month began with a series of small and irregular depressions operating over the Dominion. By the 4th these had moved off to the eastward, where they increased in depth. This condition persisted practically continuously until the 12th, there being only slight fluctuations, due to pressure waves moving from the westward. Strong southerly winds prevailed and gale force was experienced at times in many places. The 7th was a particularly unpleasant day, snow being very widespread on the high country of both Islands and extending to the low levels in the South Island. Snow and hail were, indeed, of frequent occurrence in some part or other of the Dominion throughout this period. On the 10th Gisborne had its first fall of snow for many years. Precipitation was heavy in Canterbury and Otago, and there were considerable losses of lambs.

During the 14th and 15th a rather deep depression moved past the Dominion from the westward, its centre crossing Foveaux Strait. On the 16th a cyclone developed in the northward extension of this depression

RAINFALL FOR SEPTEMBER, 1930, AT REPRESENTATIVE STATIONS.

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average September Rainfall.
	North Island.	Inches.		Inches.	Inches.
1	Kaitaia	4·57	21	0·65	5·25
2	Russell	2·94	18	0·53	4·19
3	Whangarei	5·40	23	1·30	4·96
4	Auckland	4·71	25	0·65	3·68
5	Hamilton	3·34	18	0·59	4·41
5A	Rotorua	2·80	11	0·74	5·17
6	Kawhia	3·57	17	0·79	4·58
7	New Plymouth	4·02	18	0·65	5·40
8	Riversdale, Inglewood ..	6·68	21	1·21	9·77
9	Whangamomona	5·64	14	1·45	7·32
10	Eltham	4·64	15	0·79	4·55
11	Tairua	5·00	17	1·47	4·75
12	Tauranga	3·00	19	1·11	4·43
13	Maraehako Station, Opotiki	3·60	16	1·24	4·26
14	Gisborne	3·59	18	0·63	2·95
15	Taupo	2·38	13	0·60	3·94
16	Napier	3·62	13	0·96	2·17
17	Hastings	3·10	16	0·76	2·57
18	Taihape	3·93	20	0·70	3·16
19	Masterton	3·11	18	0·53	3·05
20	Patea	2·57	19	0·48	3·64
21	Wanganui	1·72	10	0·35	2·93
22	Foxton	1·96	8	1·46	2·47
23	Wellington (Karori Reservoir)	5·55	20	1·52	3·52
	South Island.				
24	Westport	5·52	11	1·60	8·30
25	Greymouth	7·22	14	2·20	8·15
26	Hokitika	8·03	16	2·14	9·33
27	Ross	10·77	14	2·08	13·23
28	Arthur's Pass	12·85	8	3·74	15·91
29	Okuru	..	..	..	12·60
30	Collingwood	..	..	..	9·77
31	Nelson	1·49	7	0·42	3·76
32	Spring Creek	0·80	7	0·30	2·77
33	Tophouse	3·77	12	0·95	5·95
34	Hanmer Springs	4·67	16	1·25	4·10
35	Highfield, Waiau	2·52	11	1·02	3·02
36	Gore Bay	3·30	9	2·24	3·01
37	Christchurch	2·24	14	0·45	1·73
38	Timaru	2·02	14	0·90	1·93
39	Lambrook Station, Fairlie ..	3·16	12	0·86	2·19
40	Benmore Station, Clearburn	2·41	14	0·44	2·14
41	Oamaru	2·78	14	0·80	1·65
42	Queenstown	2·69	15	0·42	2·55
43	Clyde	1·23	11	0·49	1·04
44	Dunedin	3·98	18	0·72	2·76
45	Wendon	2·47	16	0·35	2·56
46	Gore	..	..	..	2·84
47	Invercargill	2·78	20	0·46	3·28
48	Puysegur Point	8·60	25	1·73	6·60
49	Half-moon Bay	3·19	19	0·65	5·45

and crossed the Auckland Peninsula during the night. Between the 14th and 17th rain was experienced in practically all parts of the country. The eastern districts of the North Island recorded heavy falls on the 16th and 17th.

The last-mentioned storm passed away gradually, and from the 23rd to the 29th a series of depressions of the westerly type followed one another across the Tasman Sea and New Zealand. It was during this interval that the west coast of the South Island received most of its rainfall for the month. The mild temperatures brought by the westerlies were a very welcome change. The last of this series of depressions passed on the 29th, and was followed by severe southerly gales which continued until the 1st October. In the North Island and Nelson the 29th was a very bitter day with frequent hailstorms, but on the east coast the 30th and 1st October were more severe. In addition to the widespread hailstorms there were heavy snowfalls on the ranges.

—Edward Kidson, Director of Meteorological Services, Wellington, 7/10/30.

CERTIFICATION OF SEED POTATOES.

CERTIFICATES ISSUED ON FINAL TUBER INSPECTION, SEPTEMBER, 1930.

Aucklander Short-top (N.Z. Sutton's Supreme).

Weeber Bros., Belfast.
F. Brundell, Camside, Kaiapoi.
J. Jellie, Russley Road, Fendalton.
W. E. Martin, R.M.D., East Eyreton.
G. Harris, Milford, Temuka.
A. J. Rich, R.M.D., Kaiapoi.
W. Oakley, R.M.D., Halkett.
D. Marshall, R.M.D., Killinchy.
F. C. Herridge, Woodend.
J. Rouse, Pareora, via Timaru.
R. Barnett, Dunsandel.
T. O'Brien, St. Andrews.
A. D. Carroll, R.M.D., Southbridge.
C. Redmond, R.M.D., Kimberley.
C. H. Jordan, R.M.D., Kaiapoi.
M. Breen, Levels.
Muff Bros., Orari.

Aucklander Tall-top (N.Z. Sutton's Supreme).

Weeber Bros., Belfast.
H. S. Moore, Box 4, Kaiapoi.
J. Warren, Russley Road, Fendalton.
J. Bailey, R.M.D., Kaiapoi.

Epicure.

D. Marshall, R.M.D., Killinchy.
G. McLachlan, R.M.D., Southbridge.
W. Shellock, R.M.D., Mead, Rakaia.

Dakota.

H. M. Marshall, R.M.D., Weedons.
W. A. McPhail, Rakaia.
W. Gee, Springlands, Blenheim.
W. J. Crozier, Mitcham, Rakaia.
E. Hinton, Templeton.
R. Hewson, Seadown, Timaru
A. J. Breakwell, Tinwald, Ashburton.
S. Cross, R.M.D., Rolleston.
C. E. Walker, R.M.D., West Melton.
Munro and Scarth, Lavington, Rakaia.

Dakota—continued.

J. H. Doak, Barr Hill, Rakaia.
J. Curragh, Templeton.
P. J. Thornton, Harewood, Christchurch.

Robin Adair.

D. Marshall, R.M.D., Killinchy.

Majestic.

A. J. Clark, Box 34, Rangiora.
C. H. Wilson, Lorneville, Invercargill.

Arran Chief.

G. Jones, "Vale Royal," Halswell.

Early Regent.

M. Kelly, 502 Lincoln Road, Halswell.
Jas. Curragh, Templeton.

King Edward.

L. King, Glencoe, R.D., Invercargill.
A. Anderson, Stirling.
J. McLeary, Mataura Island.
O. S. Mosley, Stirling.
A. H. Rose, Glencoe, R.M.D., Invercargill.
C. E. Knowler, Tuatapere.
R. M. King, Tuatapere.
W. E. Brown, Orepuki.

Iron Duke.

H. A. Hancock, Awahuri, Palmerston North.

Golden Wonder.

J. Warren, Russley Road, Fendalton.

Up to Date.

H. D. Norman, Tuatapere.
C. E. Walker, R.M.D., West Melton.

Bresee's Prolific.

D. Marshall, R.M.D., Killinchy.

NOTE.—The above will be the last list applying to the 1929–30 crop. See also lists published in the *Journal* for May, July, August, and September. The May list (provisional certificates) gave the acreage and relative cropping-power of each line.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

EFFECTS OF DEHORNING ON DAIRY CATTLE.

"Dairy-farmer," Manutuke :—

I have heard the opinion expressed that cows dehorned as calves do not produce the same amount of butterfat as horned cows, also that a dehorned bull calf will not be a good sire. I would be glad to know if you have any definite experiences in this matter.

The Live-stock Division :—

Our experience in this direction has been gleaned from farmers who have dehorned for many years, and we have not heard any of them complain that such a practice was detrimental. In fact, those who have carried out the practice long enough to obtain results speak highly of it, in as much as the herds settle down better and are more easily handled. With reference to dehorning bull calves, most of the sires used in dairy herds are pedigrees, and these as a rule are not dehorned. This being so, there have not been the same facilities for making observations. However, we fail to see how dehorning a bull calf could have any ill effects later on his progeny.

CHECKING GROWTH OF LICHENS ON EVERGREEN TREES.

G. W. PAUL, Wanganui :—

We have a number of evergreen trees which through their shady situation are becoming infested with lichens. Could you recommend a method of removing these unsightly growths?

The Horticulture Division :—

For checking the growth of lichens on evergreen trees growing in a shady position a treatment that would most likely be effective at the present time would be a Burgundy spray mixture composed of 4 lb. bluestone, 5 lb. washing-soda, and 40 gallons water, repeating the application after two to three weeks. Dissolve the bluestone with hot water, then dilute it up to 35 gallons in a wooden vessel; dissolve the soda, and dilute it to 5 gallons. Pour the soda solution slowly into the bluestone solution, stirring well meanwhile. It should be applied as a fine spray without delay, as it will otherwise lose its fine adhesive properties which make it effective for a considerable period.

ROOT FUNGUS IN LUCERNE.

"SUBSCRIBER," Whakamara, Hawera :—

Kindly advise me if there is any cure or prevention for root-fungus in lucerne. I am thinking of putting some in this year. I had a paddock of lucerne a few years ago, and it was as nice a crop as you would wish to see, but the root-fungus got into it and practically wiped the whole lot out. It has been very heavy timber country here, and I am wondering if that has anything to do with it. The fungus does not seem to attack the lucerne until it is two or three years old.

The Fields Division :—

The fungus you refer to is known as rhizoctonia, and there is reason to believe that the organism is identical with *Rhizoctonia violacea*, which is found on a large variety of plants. As the name indicates, rotting takes place, resulting in the yellowing and ultimate death of the foliage. The disease tends to occur in circular patches, which generally extend their area. It is almost impossible

to control rhizoctonia, on account of the wide range of its host plants, as well as the fact that sclerotia are formed which can remain dormant in the soil for fairly lengthy periods. The fact that your lucerne patch was on country that was previously heavily timbered would not account for the occurrence of the disease, but it might possibly occur, for instance, after a crop of mangels badly affected with what is commonly called black fungus or rhizoctonia. Should you have a repetition of the trouble in your new lucerne you would be well advised not to continue cultivation of the stand, as it is easily spread by such means over the whole area. Diseased patches should be well manured and allowed to take their chance with weeds, rather than spread the trouble over the whole field.

IODIDE OF POTASSIUM IN STOCK-LICK.

H. F. HURSTHOUSE, Blenheim :—

In the September *Journal* there is a recipe for mixing licks for stock, one of the ingredients being 3 oz. iodide of potassium, to be dissolved and sprayed over 100 lb. salt, &c. Is it not a fact that potassium iodide evaporates rapidly ? If this is so, then it seems that the greater portion of the iodide will have evaporated before the stock can get the lick.

The Live-stock Division :—

Although evaporation occurs in the case of iodine itself, potassium iodide does not evaporate. No apprehension need, therefore, be entertained on the point of loss of iodine in the lick.

NOTE.—" Invercargill Inquirer," who asks for advice regarding the blueberry, should supply name and postal address in order to obtain an answer.

KILLINGS AT MEAT-EXPORT WORKS.

THE following table, compiled from Meat Producers Board statistics, gives particulars of aggregate killings and/or equivalent output at meat-export works in New Zealand for the past five years ended 30th September. The total weight of output in 1929–30 creates a high-level record for the industry.

Year ended 30th September,	Beef Quarters.	Mutton Carcasses.	Lamb Carcasses.	Pork Carcasses.	Boned Beef =Freight Carcasses.	Frozen Sundries =Freight Carcasses.	Total Equivalent in 60 lb. Freight Carcasses.
1925–26	215,594	2,001,340	5,000,590	60,757	223,415	111,229	5,610,730
1926–27	184,331	2,094,354	5,381,121	74,633	242,044	69,534	5,956,708
1927–28	394,821	2,005,333	5,947,197	147,601	283,749	125,200	6,998,086
1928–29	151,115	1,751,979	5,971,557	159,297	161,597	153,331	6,152,695
1929–30	177,379	2,621,275	6,925,859	133,591	194,311	229,673	7,506,227

BOOKS RECEIVED.

THE ENGLISH PLOUGH, by J. B. Passmore, M.Sc., Lecturer in Agricultural Machinery, University of Reading. Oxford University Press, London : Humphrey Milford. Price 7s. 6d. net.

BELTED GALLOWAYS, by Sir Ian Hamilton, Vinton and Co., Ltd., London. Price 2s. net.

CROP PRODUCTION AND MANAGEMENT, by Joseph F. Cox, Dean of Agriculture, Michigan State College and Experiment Station. Second edition, revised. John Wiley and Sons, Inc., New York; Chapman and Hall, Ltd., London. English price 13s. 6d. net.

ROTHAMSTED EXPERIMENTAL STATION REPORT FOR 1929. Lawes Agricultural Trust, Harpenden, England. Price 2s. 6d.